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NAVY DEPARTMENT  
THE DAVID W. TAYLOR MODEL BASIN  
AERODYNAMICS LABORATORY  
WASHINGTON 25, D.C.

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE  
MODEL OF THE XAAM-N-4 ORIOLE MISSILE AND COMPARISON WITH THE  
AIRPLANE INTERFERENCE OF A 0.17-SCALE MODEL OF THE  
XAAM-N-2 SPARROW I MISSILE

PART II - MISSILES IN THE PROXIMITY OF A 0.179-SCALE  
MODEL OF THE F4D-1 AIRPLANE

by

E. M. Brower

TED No. TMB AD-3158  
(Formerly DE-3158)

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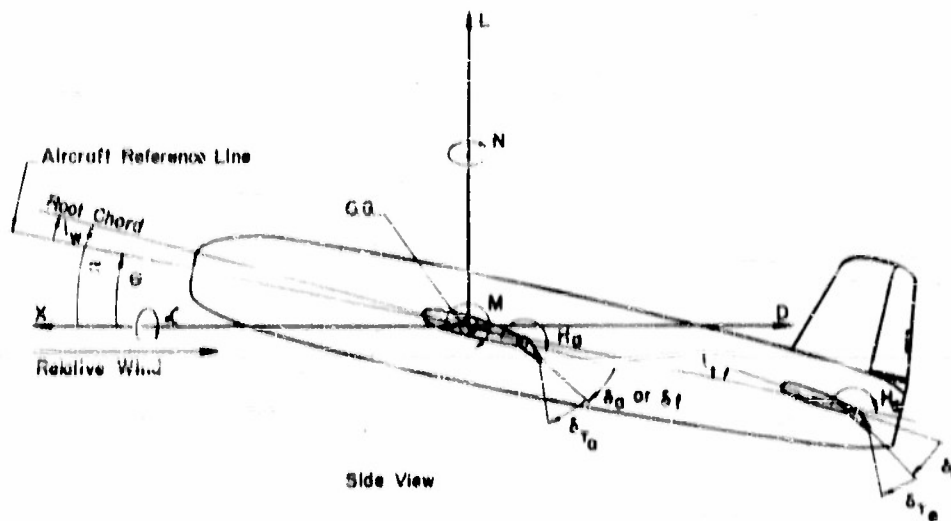
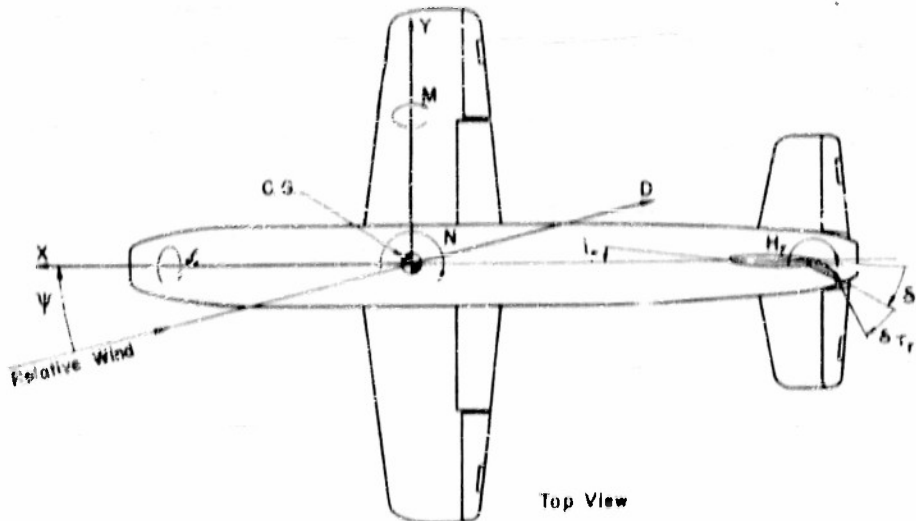
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# NOTATION

Positive directions of axes, forces, moments, and angular displacements are shown by arrows.



Axis	Force in pounds	Force Coefficient	Moment in pound-feet	Moment Coefficient
X	X	$C_X = X/qS$	$\bar{L}$ (rolling)	$C_l = \bar{L}/qSb$
D	D	$C_D = D/qS$	_____	_____
Y	Y	$C_Y = Y/qS$	M (pitching)	$C_m = M/qSc$
L	L	$C_L = L/qS$	N (yawing)	$C_n = N/qSb$
Hinge	—	_____	H (hinge)	$C_h = H/qb\bar{c}^2$

### General Symbols

S	area in square feet
c	mean aerodynamic chord in feet
b	span in feet
l	characteristic length in feet
d	diameter in feet
$\bar{c}$	root-mean-square chord in feet
q	dynamic pressure ( $\rho V^2/2$ ) in pounds per square foot
V	airspeed in feet per second
R	Reynolds number ( $\rho Vc/\mu$ , $\rho Vl/\mu$ , or $\rho Vd/\mu$ )
$\rho$	mass density of air in slugs per cubic foot
$\mu$	absolute coefficient of viscosity of air in pound-second per square foot

### Angular Settings

$\alpha$	angle of attack in degrees (angle between root-chord of wing and the projection of the relative wind vector on the plane of symmetry of the aircraft)
$\alpha'$	angle of attack in degrees (angle between root-chord of wing and the longitudinal axis of the tunnel)
$\theta$	angle of pitch in degrees (angle between the aircraft reference line and the projection of the relative wind vector on the plane of symmetry of the aircraft)
$\theta'$	angle of pitch in degrees (angle between the aircraft reference line and the longitudinal axis of the tunnel)
$\psi$	angle of yaw in degrees (angle between relative wind vector and plane of symmetry of the aircraft)
$i_w$	wing incidence in degrees (angle between the aircraft reference line and the root-chord of the wing)
$i_t$	angle of stabilizer in degrees (angle between the aircraft reference line and a reference line in the stabilizer)
$i_f$	angle of fin in degrees (angle between the plane of symmetry of the aircraft and the fin reference line)
$\delta$	angle of control surface deflection in degrees, measured in a plane perpendicular to the hinge line

### Subscripts

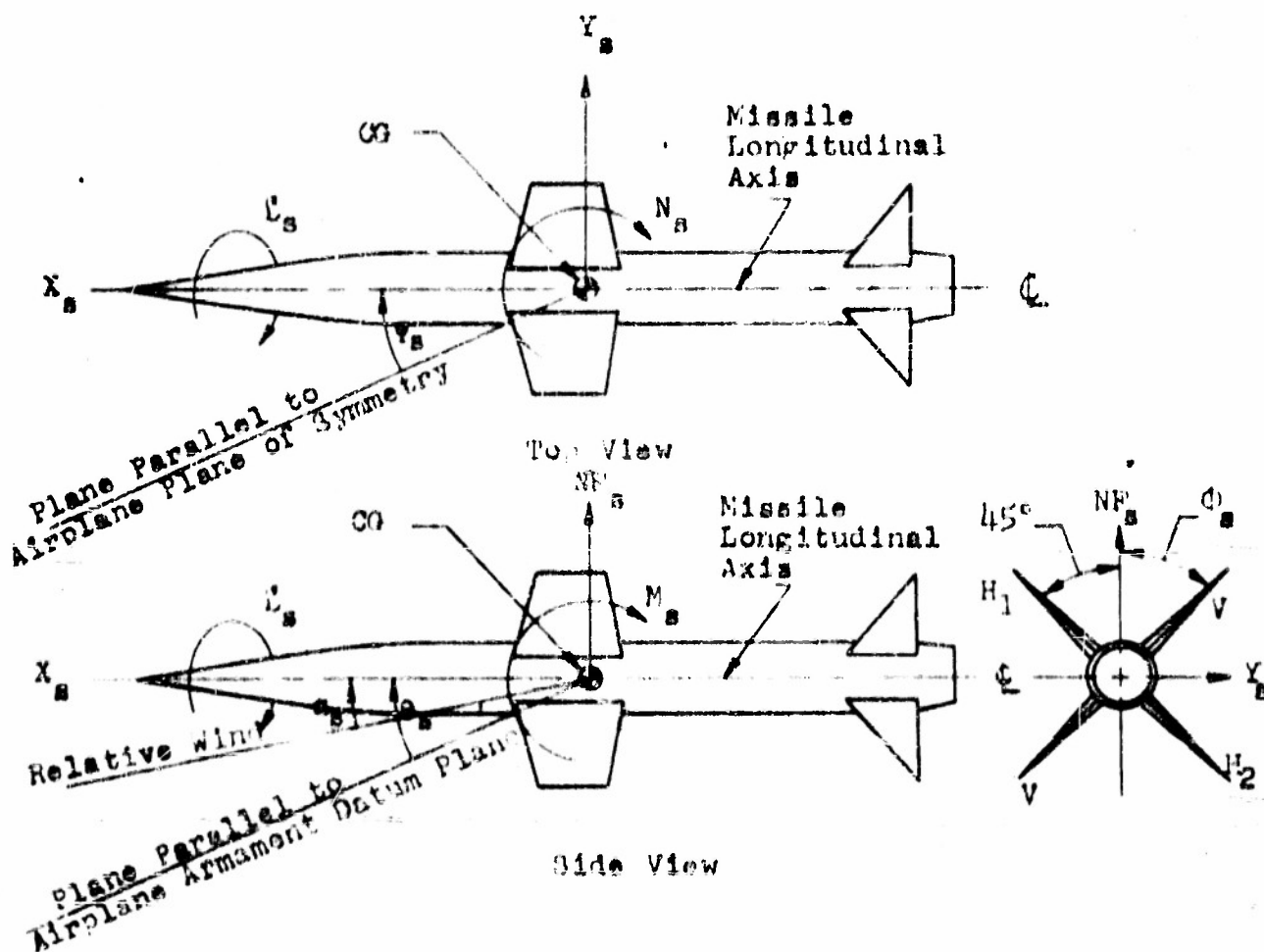
e	elevator	a	aileron	T	tab	L	left
r	rudder	f	flap	t	tail	R	right

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# NOTATION FOR MISSILE

Positive directions of axes, forces, moments, and angular displacements are shown by arrows



Axis	Force in Pounds	Force Coefficient	Moment in pound-feet	Moment Coefficient
$Y_s$	$Y_s$	$C_{Y_s} = \frac{Y_s}{qS_a}$	$M_s$ (pitching)	$C_{m_s} = \frac{M_s}{qS_a c_s}$
$N_s$	$N_s$	$C_{N_s} = \frac{N_s}{qS_a}$	$N_s$ (yawing)	$C_{n_s} = \frac{N_s}{qS_a b_s}$
$X_s$	---	---	$\ell_s$ (rolling)	$C_{\ell_s} = \frac{\ell_s}{qS_a b_s}$



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### Additional Symbols

$c_s$	mean aerodynamic chord of missile wing in feet
$b_s$	wing span of missile in feet
$S_s$	exposed area of horizontal or vertical wing of missile in square feet
$x$	distance of missile forward of initial carry position in inches (distance along the armament datum plane)
$z$	distance of missile below initial carry position in inches (distance perpendicular to the armament datum plane)
$\Delta$	used with the missile coefficient symbols as the interference of airplane on missile of the particular component noted
WL	distance above airplane horizontal reference plane in inches
BL	distance from airplane plane of symmetry in inches
FS	distance aft of airplane transverse reference plane in inches

### Angular Settings

$\theta_s$	missile angle of pitch in degrees (angle between longitudinal axis of missile and a plane parallel to the armament datum plane; positive, nose up)
$\gamma_s$	missile angle of yaw in degrees (angle between longitudinal axis of missile and airplane plane of symmetry; positive, nose right)
$\alpha_s$	missile angle of attack in degrees (angle between longitudinal axis of missile and the projection of the relative wind vector on a vertical plane through the missile longitudinal axis; positive, nose up)
$\phi_s$	missile angle of roll in degrees (angle between normal-force axis and the plane of the vertical wing; positive, clockwise)

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Angular Settings (Concluded)

$\frac{1}{2}w_{\text{subs}}$

wing incidence of missile in degrees (angle between missile reference line and root chord of the missile wing, positive when leading edge is rotated toward airplane wing) (Used with subscripts,  $H_1$ ,  $H_2$ ,  $V$ )

Subscripts

s	missile
$H_1$ , $H_2$	horizontal wing panels of missile with missile rolled $-45^\circ$ from carry position
V	vertical wing of missile with missile rolled $-45^\circ$ from carry position

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AERODYNAMICS LABORATORY  
DAVID TAYLOR MODEL BASIN  
UNITED STATES NAVY  
WASHINGTON, D.C.

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE  
MODEL OF THE XAAM-N-4 ORIOLE MISSILE AND COMPARISON WITH THE  
AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE  
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PART II - MISSILES IN THE PROXIMITY OF A 0.179-SCALE  
MODEL OF THE F4D-1 AIRPLANE

by

E. M. Brower

SUMMARY

An investigation was made in the Taylor Model Basin 8- by 10-foot wind tunnel on a 0.17-scale model of the XAAM-N-4 Oriole missile in the proximity of a 0.179-scale model of the F4D-1 airplane. A comparison is presented with a similar test on a model of the XAAM-N-2 Sparrow I missile to determine the applicability of interference data from one missile to another.

In the launch condition, the longitudinal instability of the Oriole missile increased over that of the missile alone. The instability of the missile at the outboard station is not as great as at the inboard station,

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reaching a missile-alone value of stability in approximately one-half the distance forward that it took at the inboard station. A differential missile-wing incidence of  $4^\circ$  increased the rolling-moment coefficient by 0.04 at the carry position at both the inboard and the outboard stations; however, forward of the carry position the increase was 0.02 inboard and 0.03 outboard. Owing to the proximity of the two mounting stations, there was a considerable effect on the lateral-force, yawing-moment, and rolling-moment coefficients of the missile when another missile was at the adjacent station. The airplane minimum drag was increased 0.004 by the addition of four missiles.

A comparison of the interference on the Gracle and Sparrow shows good correlation of normal-force and pitching-moment coefficients. The lateral-force and yawing-moment coefficients are a rather poor comparison; however, in all cases the agreement improves as the distance from the wing increases. The rolling-moment coefficient provides the best correlation.

#### INTRODUCTION

In flight tests, trouble has been experienced in the firing of air-to-air guided missiles. It, therefore, became advisable to conduct a series of wind-tunnel tests to determine the cause of the trouble and a means of correction. Tests were made on a model of the XAAM-N-2 Sparrow I missile

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to determine the missile characteristics in the proximity of several airplanes (References 1, 2, and 3). In order to determine whether a correlation could be made of the effects of a specific airplane on similar missiles, the Bureau of Aeronautics requested tests (Reference 4) of the XAAM-N-4 Oriole missile in the proximity of these same airplanes. The results of tests of a model of the Oriole in the proximity of a model of the F3H-1 airplane and a comparison of the airplane interference effects on the two missiles are presented in Reference 5. This report covers the characteristics of the XAAM-N-4 Oriole missile in the proximity of an F4D-1 airplane and a comparison of the airplane interference effects of the F4D-1 on the Sparrow I and Oriole missiles. The basic data of the Sparrow I in the proximity of the F4D-1 are given in Reference 2.

The tests were conducted during November and December 1953. Advance copies of these data were sent to the Bureau of Aeronautics, National Advisory Committee for Aeronautics, Sperry Gyroscope Corporation, Douglas Aircraft Company, Glenn L. Martin Company, and the Naval Air Missile Test Center shortly after completion of the tests.

#### MODEL

A 0.179-scale model of the F4D-1 airplane, designed and constructed by the Douglas Aircraft Company was used for these tests. Principal dimensions are shown in Figure 1.



A 0.17-scale model of the Oriole missile was designed and built by the TMB and is fully described in Part I of this report. A two-view drawing of the missile is shown in Figure 2 and a close-up photograph in Figure 3; other pertinent information is given in Table 1. The missile model was mounted under the left wing panel of the airplane on a five-component strain-gage-type balance, which measured all missile forces and moments except axial force. For most of the tests the balance and missile were supported from a sting mounting rig attached to the aft end of the fuselage (Figure 4). This permitted positioning the missile in several locations forward and below the airplane wing from the initial or carry position to obtain the effect of the airplane on the missile through the launch area. All movement was with respect to the carry position and parallel and perpendicular to the armament datum plane. The armament datum plane was at an angle of  $-4^\circ$  to the plane of the wing chord. Figures 5 and 6 show this type of mounting at both the inboard and outboard stations and the coordinates of the carry position are given in Table 2. Angular control was possible in only one plane while pitching or yawing the missile. It was necessary for the angle in the other planes to be zero.

A few tests were made with the balance mounted directly on the wing by means of a steel bracket enclosed



in a pylon. The purpose of these tests was to determine an optimum carry position by testing an envelope of positions. At both the inboard and outboard stations the envelope formed a trapezoidal area as outlined by the center-of-gravity locations in Figure 7. The fifth center-of-gravity location tested at each station (1 and 6) was an arbitrary point within the envelope which corresponded roughly to the carry position used for the sting-mounted or launching tests. Figure 8 shows a typical installation of this type. The various missile center-of-gravity locations in terms of airplane PS, WL, and BL are given in Figure 1 and Table 2.

Three non-instrumented dummy missile models were used to obtain interference effects due to the proximity of the missiles and the effect of four missiles on the airplane. These models were made of laminated mahogany with fiberglass wings and tail fins. They were used only when two or four missiles were mounted to the pylons.

#### TESTS

The tests were conducted in the TMB 8- by 10-foot, closed throat, atmospheric Wind Tunnel 1 at a dynamic pressure of 50.0 pounds per square foot. This corresponds to an airspeed of 123 knots and a Reynolds number of 4,170,000 for the airplane based on a wing mean aerodynamic chord of 3.269 feet. The missile Reynolds number was 211,000 based on a missile wing mean aerodynamic chord of 0.165 foot.

A missile angle-of-attack range of  $-4^{\circ}$  to  $12^{\circ}$  was used for the tests of the Oriole alone. All other tests were made with an airplane angle of attack of  $-2^{\circ}$  to  $12^{\circ}$ . The range of missile pitch and yaw,  $\theta_s$  and  $\gamma_s$ , was  $-6^{\circ}$  through  $6^{\circ}$ . Each missile wing was independently variable from  $-12^{\circ}$  to  $12^{\circ}$ . The missile was always rolled  $45^{\circ}$ . Some runs were made with the airplane yawed  $3^{\circ}$  and  $-3^{\circ}$ .

The control surfaces of the airplane were locked in the neutral position for all tests.

## RESULTS

The results are presented in the form of non-dimensional aerodynamic coefficients of the missile and airplane. Figure 9 is included from some later tests of the missile alone. Five-component missile characteristics are presented in Figures 10 through 21 and the airplane longitudinal characteristics in Figure 22. The data are referred to the system of axes shown in the notation with the center of gravity of the missile and airplane as shown in Figures 1 and 2. The missile coefficients are based on the exposed area, mean aerodynamic chord, and span of the missile wing. Airplane coefficients were based on area, span, and mean aerodynamic chord of the F4D-1 wing. The missile wing incidence was zero for all tests except those of Figures 13 and 18. The tests made with the sting mounting were made with a pylon on; Pylon 1 at the inboard station, and Pylon 6 at

the outboard station, unless otherwise noted. A comparison of the airplane interference effects on the Oriole and Sparrow I missiles is presented in Figures 24 through 33. Tables 3, 4, and 5 present a test schedule of the results showing where the various conditions may be found in the curves.

No jet-boundary corrections were applied to the missile coefficients. The airplane data were corrected for tare and interference of the supports and by the following jet-boundary corrections:

$$\Delta \alpha = 1.548 C_L$$

$$\Delta C_D = 0.0270 C_L^2$$

$$\Delta C_m = 0$$

The drag coefficient was also corrected for the static pressure gradient by the addition of an increment of 0.0007. The dynamic pressure was corrected during the test for model blockage.

#### DISCUSSION

The aerodynamic characteristics of the XAAM-N-4 Oriole missile model alone are shown in Figure 9. For this test, the missile sting-mounting system was similar to that used for mounting on the airplane. The Oriole is of symmetrical design; therefore, the displacements in pitching-moment and yawing-moment coefficients at  $\alpha_s = 0^\circ$  are assumed to be due to the mounting rig.

ORIOLE ON P4D-1 -- A composite plot of the missile characteristics at the inboard station for various distances forward and below the wing with  $\theta_s = \gamma_s = 0^\circ$  is presented in Figure 10. The Oriole is unstable in the launch condition for all positions tested; however, it becomes more stable as the distance forward and below the wing increases. At 18.36 inches forward of the carry position,  $\partial C_{m_s} / \partial \alpha$  is approximately the same for all positions below the wing and for the missile alone. Generally  $\partial C_{N_s} / \partial \alpha$  increases with increasing distance from the wing. The yawing-moment coefficient approaches zero as the missile moves away from the wing. The rolling moment coefficient is quite high while in the influence of the pylon and decreases to approximately zero at  $x = 18.36$  inches.

At the inboard station,  $\partial C_{N_s} / \partial \alpha$  increases from 0.11 at  $x = 6.12$  to 0.18 at  $x = 15.36$  with  $z = 0$ . The pitching-moment coefficient over the same distance shows small change per degree of  $\theta_s$  (Figure 11). The normal-force-coefficient slope increases even more as the distance below the wing increases.

The tests with the missile yawed (Figure 12) show that the tail fins have an effect especially in close proximity to the fuselage. The  $\partial C_{Y_s} / \partial \gamma_s$  is always larger through the negative yaw range except at the carry position. The yawing-moment coefficient becomes more negative with increasing distance forward of the carry position to  $x = 13.26$

inches at  $\alpha = 0^\circ$ . At  $x = 18.36$  inches forward,  $C_{n_s}$  reverses and becomes slightly more positive at all yaw angles. The  $\partial C_{n_s} / \partial \alpha$  increases from a negative to a positive value as the  $x$ -distance increases.

Figure 13 presents the variation due to missile wing incidence at various stations forward of the carry position and two angles of missile pitch. A differential wing setting of  $1/4^\circ$  has the maximum effect on the rolling-moment coefficient at the carry position, approximately  $0.04 C_L$ , which decreases rapidly to 0.02 as the distance forward increases. In all cases the increment is independent of the airplane angle of attack. A wing incidence setting equal on all four wings produces a  $\partial C_{N_s} / \partial i_{w_s}$  of about 0.055 at the carry position. As the distance forward increases,  $\partial C_{N_s} / \partial i_{w_s}$  becomes less linear especially through the positive incidence range (Figure 13g). At  $\theta_s = 6^\circ$ ,  $\partial C_{N_s} / \partial i_{w_s}$  becomes non-linear closer to the carry position. The increment of pitching-moment coefficient due to  $i_{w_s}$  is about equal through the wing-incidence range,  $12^\circ$  to  $-12^\circ$ , and at all missile locations.

The effects on the sting-mounted missile of airplane yaw and a pylon are shown in Figure 14 for the inboard station. At the carry position and  $\gamma = 0^\circ$ , the presence of the pylon increases  $\partial C_{l_s} / \partial \alpha$  from 0.0008 to 0.0145 and decreases  $\partial C_{n_s} / \partial \alpha$  from -0.0362 to -0.0506. The increment of

$C_{n_y}$  per degree of yaw is larger through the positive than through the negative range both with and without the pylon. This same characteristic is present with the missile as far from the airplane wing as  $z = 4.08$  inches,  $x = 0$  inch and  $z = 2.04$  inches,  $x = 18.36$  inches. Lateral force showed small variation due to airplane yaw at the three missile positions tested.

The tests at the outboard station were similar to those for the inboard station. Figure 15 presents the comparative results at various distances forward and below the carry position for  $\theta_s = \gamma_s = 0^\circ$ . The interference of the F4D-1 on the Oriole missile at the carry position and the outboard station increases the longitudinal instability of the missile. The longitudinal stability becomes approximately equal to that of the missile alone at  $x = 9.18$  inches. As would be expected the rolling-moment coefficient is greater outboard than inboard. The trends and changes due to increasing  $z$  distance are essentially the same as at the inboard station. Longitudinal instability decreases with increasing distance below the wing.

The results of the missile tests due to missile pitch, yaw, and wing incidence at the outboard station are presented in Figures 16, 17, and 18. Missile pitch causes results similar to those at the inboard station; however,  $\partial C_{m_s} / \partial \theta_s$  shows less variation with distance forward at the

outboard station. At distances of 13.26 and 18.36 inches forward of the carry position,  $\partial C_{m_s} / \partial \theta_s$  increases with increasing  $\theta_s$ . Forward of the carry position the forces on the missile at the outboard station are very similar to those on it at the inboard station. A differential missile-wing incidence of  $14^\circ$  at the carry position gives approximately the same amount of rolling-moment increment as at the inboard station. This decreases to 0.030 at 18.36 inches forward, which is only half as much a decrease as at the inboard station. The rolling-moment coefficient is larger outboard than inboard. The results of equal wing incidence on the normal-force coefficient are approximately the same as at the inboard station.

The effect of a pylon (Figure 19) on the rolling-moment coefficient at the outboard station is slightly greater than at the inboard station. Without the pylon,  $\partial C_{l_s} / \partial \alpha$  is -0.0008 in comparison to 0.0008 at the inboard station. The  $\partial C_{l_s} / \partial \alpha$  with the pylon on is the same at both stations. The rolling-moment coefficient is more positive outboard. Again the effect of airplane yaw varies little in general trend from the inboard station.

For use in determining the carry position for the missile, four locations were tested inboard and outboard as described under "Model." These results are presented in Figure 20.



Figure 21 presents the results of tests to determine the interference of a second missile at the adjacent station. In both cases there was an effect on the lateral-force, yawing-moment, and rolling-moment coefficients. The second missile decreased the lateral force and caused an effective deflection of the air flow in the area between the missiles increasing  $C_{n_s}$  at the inboard station and decreasing it at the outboard station. The rolling-moment coefficient of the inboard missile was reduced with a missile outboard. The rolling-moment coefficient of the missile showed a reduction in slope with airplane angle of attack due to the second missile. As can be seen in Figure 1, the two missiles are in close proximity spanwise and at the same chord-wise position rather than at a constant percent of the wing chord; therefore a rather large interference should be expected.

The drag increase of the airplane caused by four missiles is shown in Figure 22 for both the inverted and erect model conditions. The support system necessitated having the tail off when the model was inverted; however, with the tail on and the model erect,  $C_{D_{min}}$  was increased only 0.002 over the tail-off configuration. The addition of the four missiles gave a drag increment of 0.004. The increase in  $C_L$  and decrease in longitudinal stability are small.



COMPARISON OF ORIOLE AND SPARROW I MISSILES -- A comparative sketch of the Oriole missile and the Sparrow I missile is given as Figure 23. The Oriole has a shorter body length, larger body diameter, smaller exposed wing area, and larger tail-fin area than the Sparrow I. A comparison of the F4D-1 airplane interference effects on the two missiles was made to determine whether or not the interference effects on a missile are dependent on missile design and what correlation can be made for various designs. The comparative data are presented in Figures 24 through 33 for the various components as functions of distance forward of the carry position and missile angle of attack. Because of the lack of data from the Sparrow I tests the comparison is omitted at  $x = 1.02$  inches inboard station. Interference is calculated as the value of the coefficient in the presence of the airplane minus the value of the missile-alone coefficient. It should be noted here that the interference presented includes the effect of the airplane on the mounting rig. The magnitude and variability of this effect with pitch angle are not known; however, they are assumed to be small. For all components the correlation improves as the distance from the wing increases both forward and down.

Figure 24 presents the interference of the airplane on the normal-force coefficient of the missiles plotted against distance forward of the carry position for high

and low airplane angle of attack at  $\theta_a = 0^\circ$ . The agreement between the Oriole and the Sparrow at the outboard station is very good at the low airplane angle of attack; even so, improvement can be noted with increasing distance below the wing. At the high airplane angle of attack the agreement at the outboard station is not good. For the inboard station there is considerably less difference in the degree of correlation at high and low airplane angles of attack. When compared on the basis of missile angle of attack (Figure 25), the best correlation inboard and outboard is at  $\alpha_m$  less than  $0^\circ$ . The agreement is poorest from  $\alpha_m = 2^\circ$  through  $6^\circ$  in close proximity to the wing.

Airplane interference on the missile pitching-moment coefficient is presented in Figures 26 and 27. As was the case with the normal-force coefficients the outboard station provides the best correlation at the low airplane angle of attack. At high airplane angles of attack and in close proximity to the wing the missile pitching-moment coefficients correlate better at the inboard station; at  $z = 2.04$  the correlation at the outboard station is again better. The comparison versus missile angle of attack is very good especially at 18.36 inches forward of the carry position. Again the interference at the outboard station is more nearly equal for the two missiles than at the inboard station.

The airplane interference on the lateral-force coefficient (Figures 28 and 29) is rather high for both missiles; however, the  $\Delta C_{Y_s}$  on the Sparrow is always less than on the Oriole. At high angles of attack the correlation between the missiles is very poor. From Figure 29 it is apparent that the degree of the correlation does not appreciably vary with missile angle of attack.

The interference on the yawing-moment coefficient (Figure 30) indicates the same trends for both missiles. In most cases there is an almost constant difference in interference between the Oriole and Sparrow over the 18 inches of forward travel tested. At the low angle of attack the numerical correlation is poor and the interference of the inboard and outboard stations of one missile are in closer agreement. A large difference between the interference of the two missiles at the high airplane angle of attack is shown in Figure 31.

The interference of the F4D-1 on the rolling-moment coefficients (Figure 32) of the two missiles is high at the carry position and decreases with increasing distance forward until it approaches zero at about  $x = 15$  inches for the low airplane-angle-of-attack condition. At the high airplane angle of attack,  $\Delta C_{l_s}$  is very high at  $x = 0$  inch, especially for the Oriole outboard, and approaches zero at 17 inches forward of the carry position. At  $z = 2.04$  inches

for both high and low angle of attack,  $AC_{L_s}$  is less than 0.01 and shows little change with increasing distance forward. In most cases there is very small variation with missile angle of attack at  $\alpha = 0^\circ$  and  $6^\circ$  (Figure 33).

#### CONCLUSIONS

1. The interference of the F4D-1 increased the longitudinal instability of the Oriole missile at the carry position. Missile-alone stability was approached at 18.36 inches forward for the inboard station and 9.18 inches forward for the outboard station.

2. A differential missile-wing incidence of  $4^\circ$  increased  $C_{L_s}$  from 0.02 to 0.04 depending on distance forward at the inboard station and from 0.03 to 0.04 at the outboard station.

3. The presence of the pylon increased the rolling-moment coefficient greatly at the carry position. The increase was greater at the outboard station owing to span-wise flow.

4. A missile at the adjacent station produced a large effect on lateral-force, yawing-moment, and rolling-moment coefficients because of the proximity of the two missiles.

5. There was an increase of 0.004 in  $C_{D_{min}}$  of the airplane with the addition of four missiles.

6. The interference correlation of the F4D-1 airplane on the normal-force and pitching-moment coefficients

of the Oriole and Sparrow missiles was generally good.

7. The agreement of the interference on the lateral-force and yawing-moment coefficients was rather poor. Some difficulty might be experienced in predicting this interference on other missiles.

8. The interference on the missile rolling-moment coefficients showed the best correlation. The effects of the pylon at the carry position were slightly unpredictable.

Aerodynamics Laboratory  
David Taylor Model Basin  
Washington, D. C.  
August 1954

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5. Brower, E. M.; Wind-Tunnel Tests of the Airplane Interference on a 0.17-Scale Model of the XAAM-N-4 Oriole Missile and Comparison With the Airplane Interference on a 0.17-Scale Model of the XAAM-N-2 Sparrow I Missile. Part I - Missiles in the Proximity of a 0.15-Scale Model of the F3H-1 Airplane. (U. S.) TMB Aero Report 864, Part I, June 1954. 152 l. incl. illus. CONFIDENTIAL

TABLE 1

## Principal Dimensions and Data for the KAAM-N-4 Oriole Missile

Component	Item	0.17-Scale	Full-Scale
Body	Length in inches	23.46	138.00
	Diameter in inches	1.87	11.00
Wing	Exposed area (horizontal or vertical) in square feet	0.0574	2.00
	Span in feet	0.549	3.23
	MAC in feet	0.165	0.97
	Airfoil section	1/4% double wedge	1/4% double wedge
	Aspect ratio	2.65	2.65
	Incidence range (horizontal) in degrees	±12	±16
	Incidence range (vertical) in degrees	±12	±20
Tail	Exposed area (horizontal or vertical) in square feet	0.065	2.25
	Airfoil section	2.8% double wedge	2.8% double wedge
	Aspect ratio	0.90	0.90
Center-of-gravity location		FS 14.67	FS 86.30

TABLE 2

Center-of-Gravity Locations of Missile Model for Various  
Mounting Positions in Terms of P&D-1 Model Stations

Mounting	Inboard Station		
	PS	WL	BL
Sting	51.57	-5.31	16.26
Pylon 1	51.43	-5.27	16.31
Pylon 2	48.49	-4.34	16.24
Pylon 3	48.63	-6.34	16.28
Pylon 4	51.46	-6.27	16.29
Pylon 5	51.47	-4.34	16.30
Mounting	Outboard Station		
	PS	WL	BL
Sting	51.49	-4.90	22.81
Pylon 6	51.58	-4.83	22.97
Pylon 7	50.70	-4.22	22.90
Pylon 8	50.58	-5.50	22.96
Pylon 9	54.63	-5.64	22.88
Pylon 10	54.63	-4.41	22.92



TABLE 3

Outline of Tests and Index of Test Results

Variation of Missile Characteristics With Missile Angle of Attack				Figure
Test				9
Missile alone				
Variation of Missile Characteristics With Airplane Angle of Attack (Missile in Proximity of Airplane)				Figure
Test				10
Missile positions ahead of carry position; $\psi=0^\circ$ , $\psi_s=0^\circ$ , $\theta_s=0^\circ$ , $z=0$ "				10
$x=0$ ", 3.06", 6.12", 13.26", 18.36" }                 inboard station outboard station				15
Effect of missile pitch; $\psi = 0^\circ$ , $\psi_s = 0^\circ$				
$\theta$ in degrees	$x$ in inches	$z$ in inches	Station*	
6,3,0	6.12	0	In.	11a
6,3,0	6.12	0	Out.	16a
6,3,0	9.18	0	In.	11b
6,3,0	9.18	0	Out.	16b
6,3,0	13.26	0	In.	11c
6,3,0	13.26	0	Out.	16c
6,3,0,-3,-5	18.36	0	In.	11d
6,3,0,-3,-5	18.36	0	Out.	16d
6,3,0,-3	6.12	1.02	In.	11e
6,3,0,-3	6.12	1.02	Out.	16e
3,0,-3	9.18	1.02	In.	11f
0,-3,-6	13.26	1.02	In.	11g
0,-3,-6	13.26	1.02	Out.	16f
6,3,0,-3,-6	18.36	1.02	In.	11h
6,3,0,-3,-6	18.36	1.02	Out.	16g
6,3,0,-3,-6	0	2.04	In.	11i
6,3,0,-3,-6	0	2.04	Out.	16h
6,3,0,-3,-6	6.12	2.04	In.	11j
6,3,0,-3,-6	6.12	2.04	Out.	16i

\* In. refers to the inboard station, BL = 16.26  
 Out. refers to the outboard station, BL = 22.87

TABLE 3 (Continued)

Test				Figure	
Effect of missile pitch; $\Psi = 0^\circ, \Psi_s = 0^\circ$ (Continued)					
$\theta$ in degrees	x in inches	z in inches	Station*		
0,-3,-6	13.26	2.04	In.	11k	
0,-3,-6	18.36	2.04	In..	11l	
0,-3,-6	18.36	2.04	Out.	16j	
6,0,-6	0	4.08	In.	11m	
6,0,-6	0	4.08	Out.	16k	
Effect of missile yaw; $\Psi = 0^\circ, \theta_s = 0^\circ, z = 0''$					
$\Psi$ in degrees	x in inches	Station*	Pylon		
2,0,-2	0	In.	On	12a	
2,0,-2	0	Out.	On	17a	
3,0,-3	6.12	In..	On	12b	
3,0,-3	13.26	In.	On	12c	
3,0,-3	13.26	In.	Off	12d	
3,0,-3	13.26	Out.	On	17b	
3,0,-3	13.26	Out.	Off	17c	
6,3,0,-3,-6	18.36	In.	On	12e	
6,3,0,-3,-6	18.36	Out.	On	17d	
Effect of missile wing-incidence settings; $\Psi = 0^\circ, \Psi_s = 0^\circ, z = 0''$					
$\theta =$ in degrees	$i_{wy}$ in degrees	$i_{wv}$ in degrees	x in inches	Station*	
0	0,4,4,-8	0,4,-8	0	In.	13a
0	0,4,4,-8,-12	0,4,-8,-12	0	Out.	18a
0	0,4,4,-8	0,4,-8	6.12	In.	13b
6	0,4,4,-8	0,4,-8	6.12	In.	13c
0	0,4,12,8,4,-4,-8,-12	0,12,8,4,-4,-8,-12	13.26	In.	13d
6	0,4,12,8,4,-4,-8,-12	0,12,8,4,-4,-8,-12	13.26	In.	13e

TABLE 3 (Concluded)

Test					Figure	
Effect of missile wing-incidence settings; $\gamma = 0^\circ, \gamma_s = 0^\circ, z = 0"$						
$\theta_n$ in degrees	$1_{wH}$ in degrees	$1_{wV}$ in degrees	x in inches	Station*		
0	0, $\pm 4, 12, 8,$ 4, -4, -8, -12	0, 12, 8, 4, -4, -8, -12	13.26	Out.	18b	
6	0, $\pm 4, 12, 4,$ -4, -12	0, 12, 4, -4, -12	13.26	Out.	18c	
0	0, $\pm 4, 12, 8,$ 4, -4, -8, -12	0, 12, 8, 4, -4, -8, -12	18.36	In.	13f	
6	0, $\pm 4, 12, 8,$ 4, -4, -8, -12	0, 12, 8, 4, -4, -8, -12	18.36	In.	13g	
0	0, $\pm 4, 12, 8,$ 4, -4, -8, -12	0, 12, 8, 4, -4, -8, -12	18.36	Out.	18d	
6	0, $\pm 4, 12, 4,$ -4, -12	0, 12, 4, -4, -12	18.36	Out.	18e	
Effect of airplane yaw; $\gamma_n = 0^\circ$						
$\theta_n$ in deg.	$\gamma$ in deg.	x in in.	z in in.	Pylons	Station**	
0	3, 0, -3	0	0	1 on, off	In.	14a
0	3, 0, -3	0	0	6 on, off	Out.	19a
0	3, 0, -3	18.36	2.04	1	In.	14b
0	3, 0, -3	18.36	2.04	6	Out.	19b
0	3, 0, -3	0	4.08	1	In.	14c
0	3, 0, -3	0	4.08	6	Out.	19c
Effect of pylons; $\gamma_n = 0^\circ, \theta_n = 0^\circ, \gamma = 0^\circ$						
Pylons			Station**			
1, 2, 3, 4, 5,			In.		20a	
6, 7, 8, 9, 10			Out.		20b	
Effect of dummy missile and of airplane yaw; $\theta_n = 0^\circ, \gamma_n = 0^\circ, x = 0", z = 0"$						
$\theta_n$ in degrees	$\gamma$ in degrees	Dummy	Station*			
	3, 0, -3	on and off	In.		21a	
	3, 0, -3	on and off	Out.		21b	
Airplane longitudinal characteristics						
Model inverted, tail off					22a	
Model erect, tail on					22b	

TABLE 4

Index of Figures Showing Variation of Airplane Interference  
With Distance Forward of the Carry Position

Interference Coefficient	$\theta_s$ in degrees	$\alpha_s$ in degrees	$\alpha$ in degrees	Figure
$\Delta C_{N_s}$	0	0	4	24a
	0	6	10	24b
$\Delta C_{m_s}$	0	0	4	26a
	0	6	10	26b
$\Delta C_{Y_s}$	0	0	4	28a
	0	6	10	28b
$\Delta C_{n_s}$	0	0	4	30a
	0	6	10	30b
$\Delta C_{l_s}$	0	0	4	32a
	0	6	10	32b

In each figure interference is shown for both the inboard and outboard stations and at the three positions,  $z = 0$  inch, 1.02 inches, and 2.04 inches.

TABLE 5

Index of Figures Showing Variation of Airplane  
Interference With Missile Angle of Attack

Interference Coefficient	z in inches	x in inches	Station*	Figure
$\Delta C_{N_s}$	0	18.36	In.	25a
	0	9.18, 18.36	Out.	25b
	1.02	6.12, 13.26, 18.36	Out.	25c
	2.04	0, 6.12, 13.26	In.	25d
	2.04	0, 6.12, 18.36	Out.	25e
	4.08	0	In.	25f
	4.08	0	Out.	25g
$\Delta C_{m_s}$	0	18.36	In.	27a
	0	9.18, 18.36	Out.	27b
	1.02	6.12, 13.26, 18.36	Out.	27c
	2.04	0, 6.12, 13.26	In.	27d
	2.04	0, 6.12, 18.36	Out.	27e
	4.08	0	In.	27f
	4.08	0	Out.	27g
$\Delta C_{Y_s}$	0	18.36	In.	29a
	0	9.18, 18.36	Out.	29b
	1.02	6.12, 13.26, 18.36	Out.	29c
	2.04	0, 6.12, 13.26	In.	29d
	2.04	0, 6.12, 18.36	Out.	29e
	4.08	0	In.	29f
	4.08	0	Out.	29g

TABLE 5 (Concluded)

Interference Coefficient	z in inches	x in inches	Station*	Figure
$\Delta C_{n_8}$	0	18.36	In.	31a
	0	9.18, 18.36	Out.	31b
	1.02	6.12, 13.26, 18.36	Out.	31c
	2.04	0, 6.12, 13.26	In.	31d
	2.04	0, 6.12, 18.36	Out.	31e
	4.08	0	In.	31f
	4.08	0	Out.	31g
	0	18.36	In.	33a
$\Delta C_{1_8}$	0	9.18, 18.36	Out.	33b
	1.02	6.12, 13.26, 18.36	Out.	33c
	2.04	0, 6.12, 13.26	In.	33d
	2.04	0, 6.12, 18.36	Out.	33e
	4.08	0	In.	33f
	4.08	0	Out.	33g

In each figure the interference is shown at both  $\alpha = 0^\circ$  and  $6^\circ$ .

\* in. refers to the inboard station, BL = 16.26  
Out. refers to the outboard station, BL = 22.87

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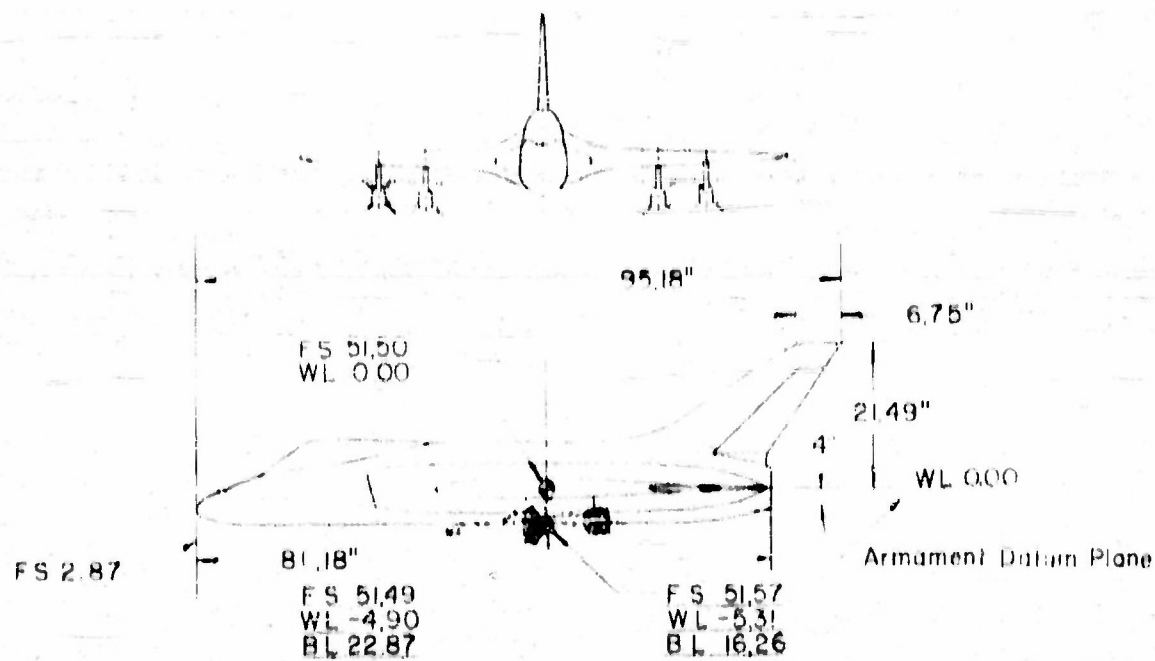
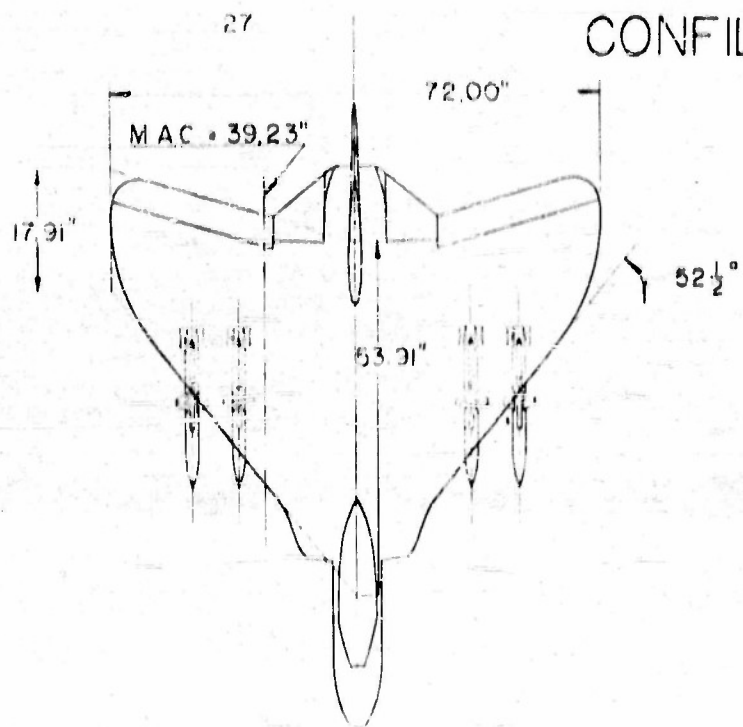


Figure 1 Principal Dimensions of a 0.179-Scale Model of the F4D-1 Airplane With Oriole Missiles

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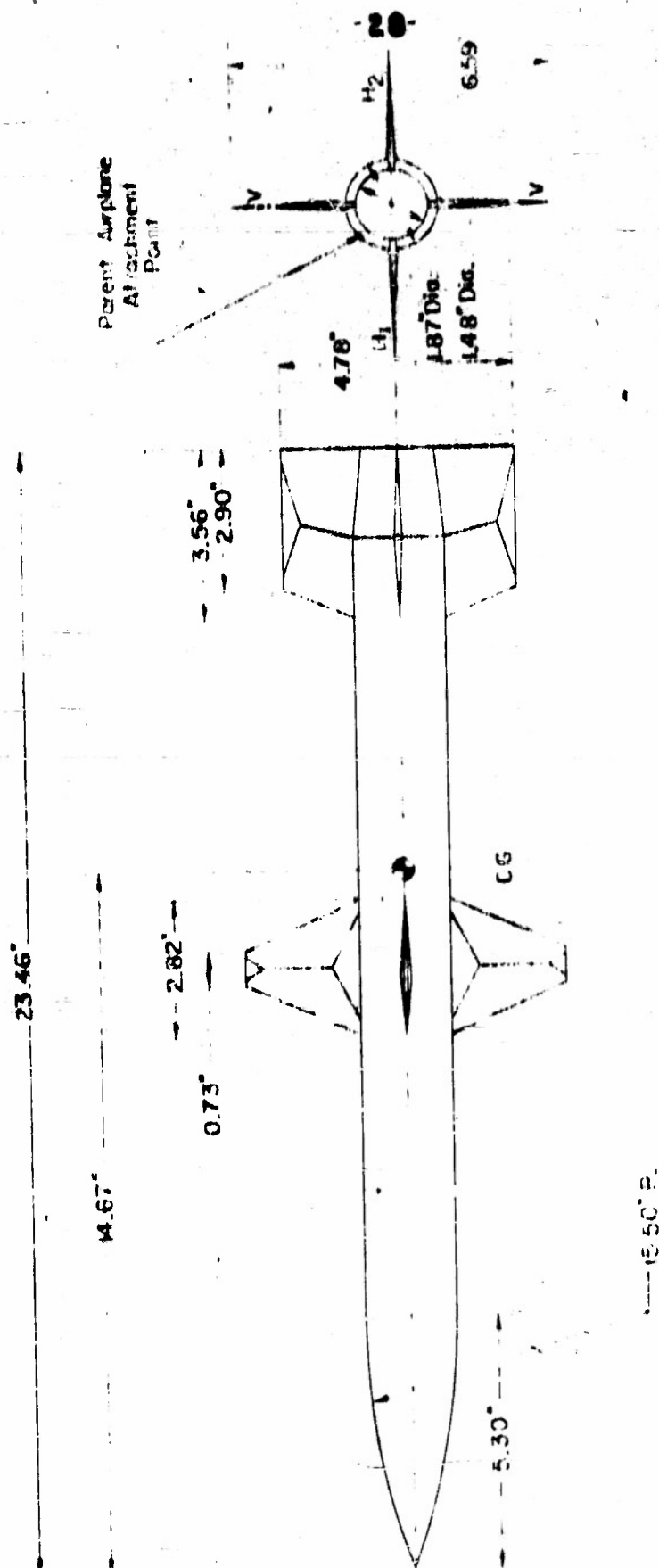


Figure 2-Principal Dimensions of a 0.17-Scale Model XAAM-N-4 Oriole Missile

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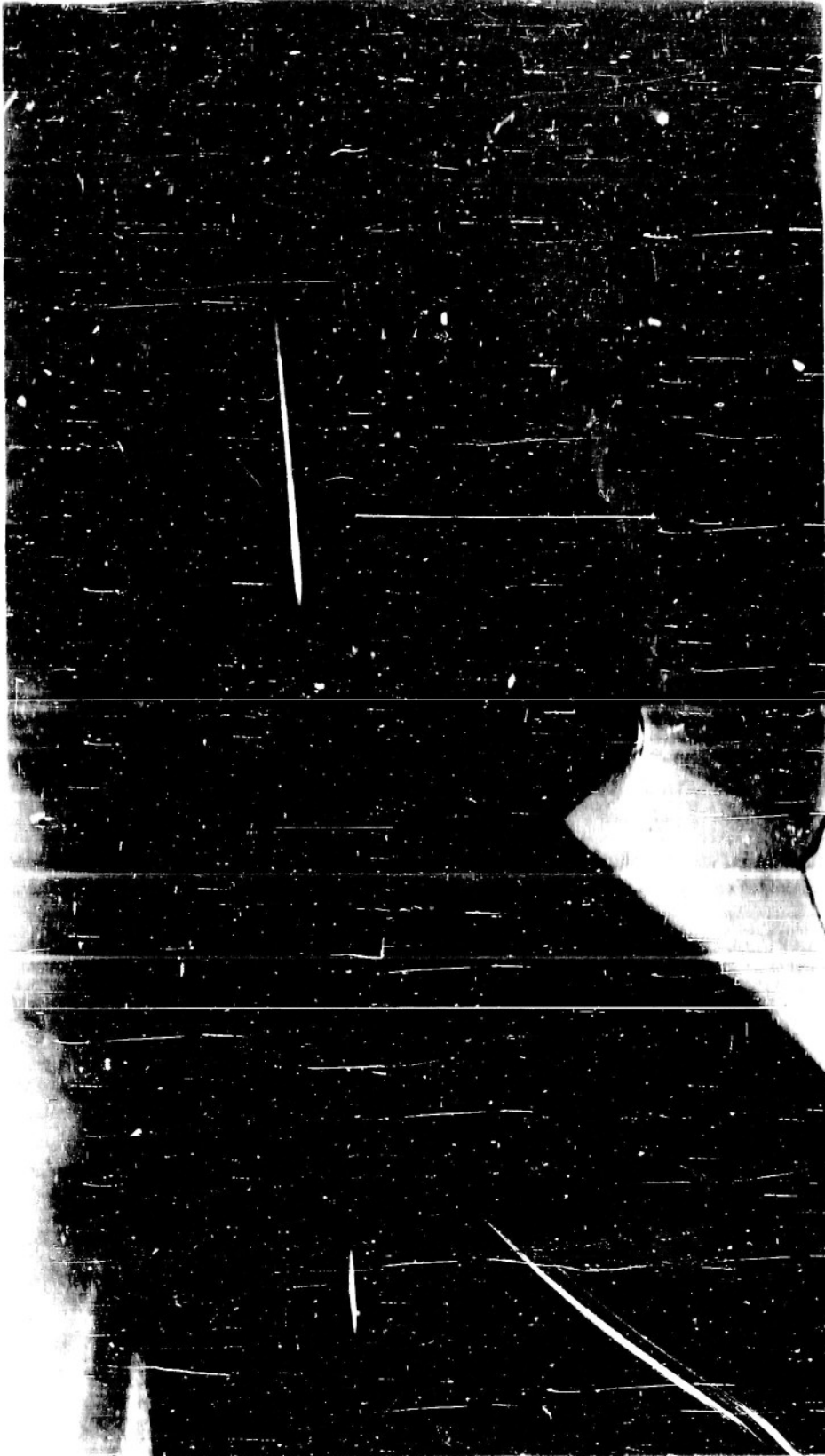


Figure 3 - Close-up of a 0.17-Scale Model XAAM-F-4 Oriole Missile  
in the Proximity of a Model F4D-1 Airplane

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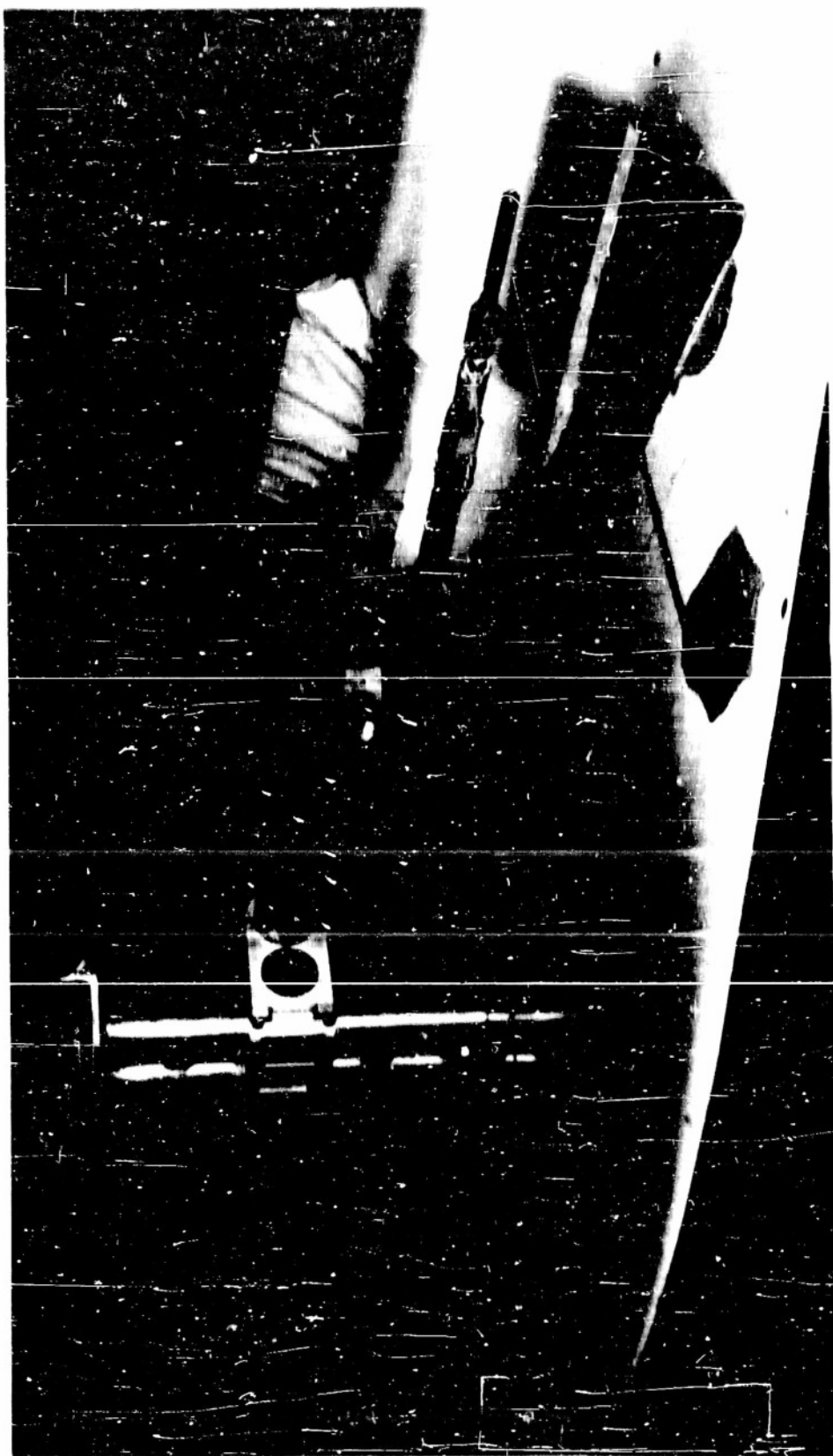


Figure 4 - Close-Up View Showing Strain-Gage Balance and Sting-Mounting System on a  
0.179-Scale Model F4D-1 Airplane Installed Inverted in the Wind Tunnel

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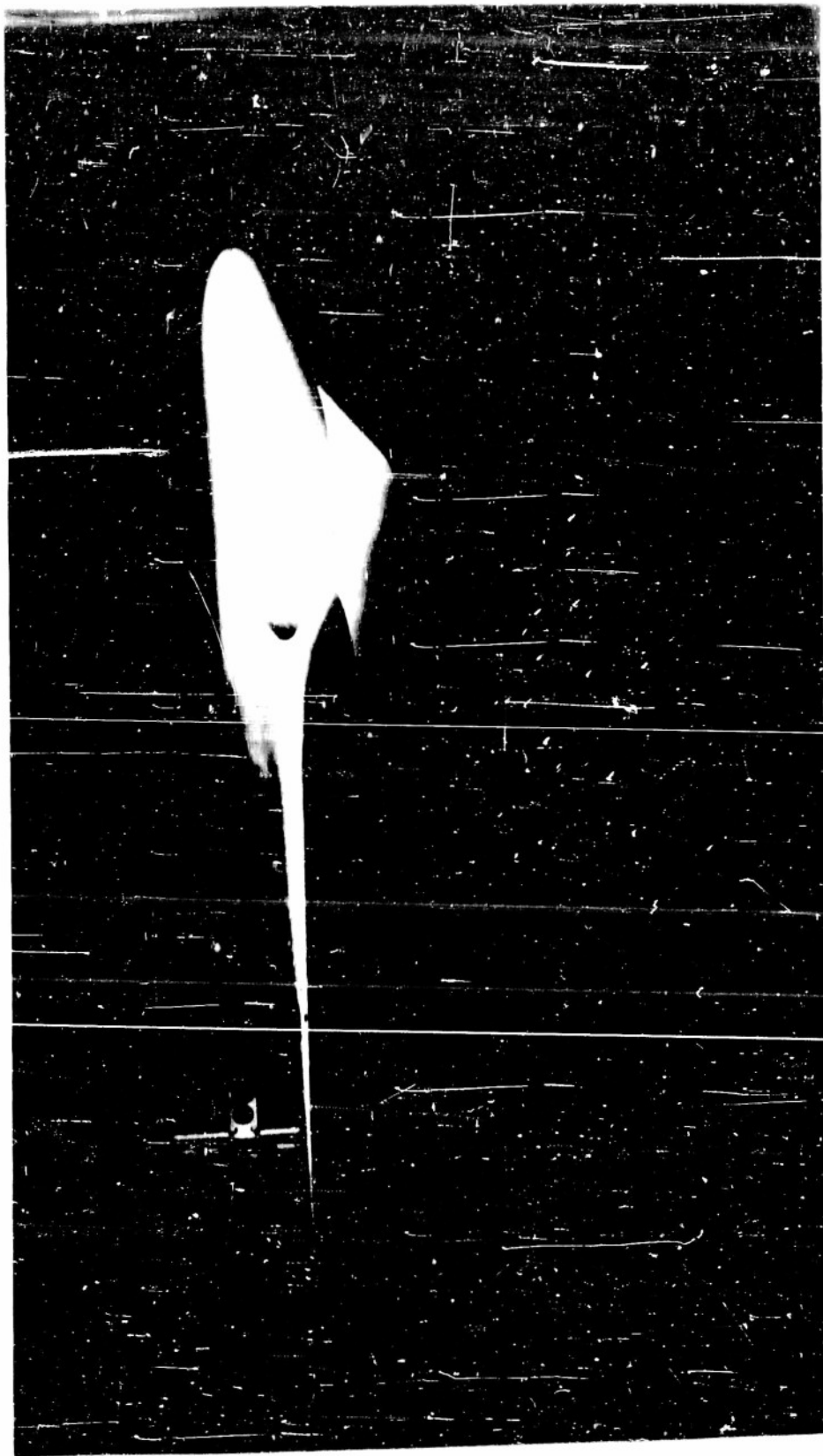


Figure 5 - View of a 0.17-Scale Model XAAM-N-4 Oriole Missile Sting Mounted at the Inboard Station (EL 16.26) on a 0.179-Scale Model F4D-1 Airplane Installed Inverted in the Wind Tunnel,  $\alpha = 13.26^\circ$ ,  $\beta = 0^\circ$

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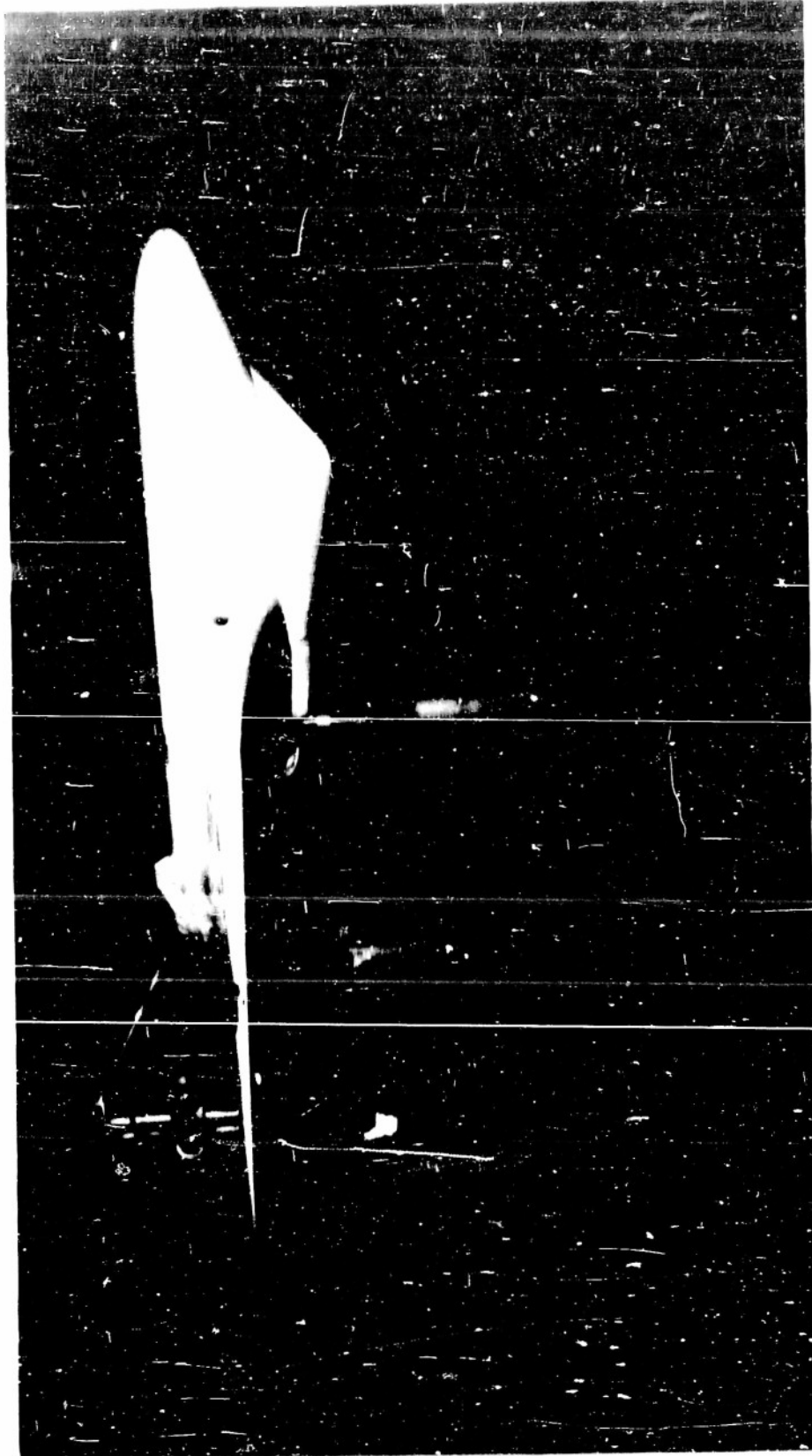


Figure 6 - View of a 0.17-Scale Model XAAM-H-4 Oriole Missile Sting Mounted  
at the Outboard Station (EL 22.81) on a 0.179-Scale Model PHD-1  
Airplane Installed Inverted in the Wind Tunnel,  $x = 0''$ ,  $z = 0''$

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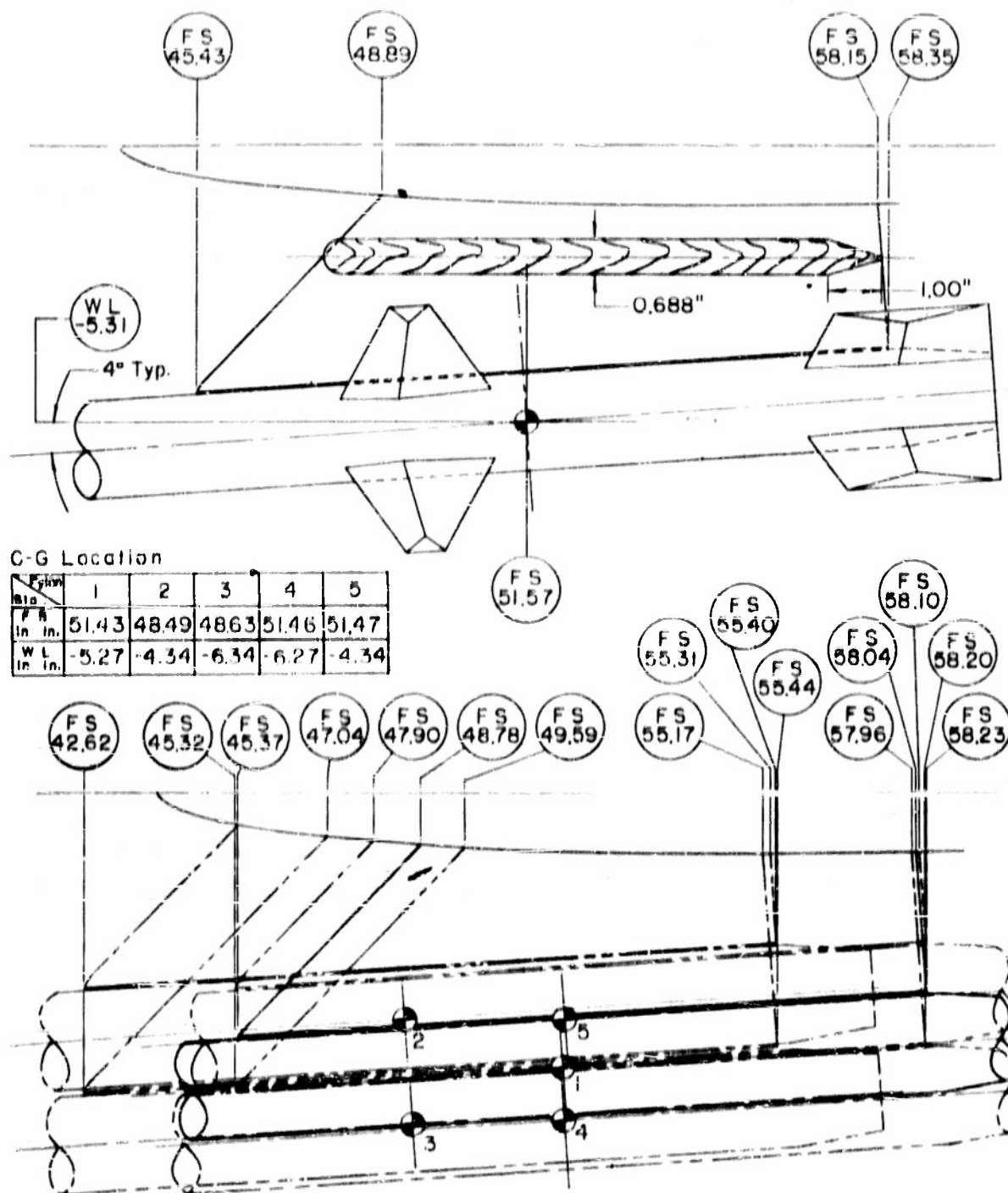


Figure 7 Pylon Design and Missile Center-of-Gravity Locations  
for Attachment of a 0.17-Scale Model XAAM-N-4  
Orloff Missile on a 0.179-Scale Model F4D-1 Airplane  
(a) Inboard Station (B L 16 26)

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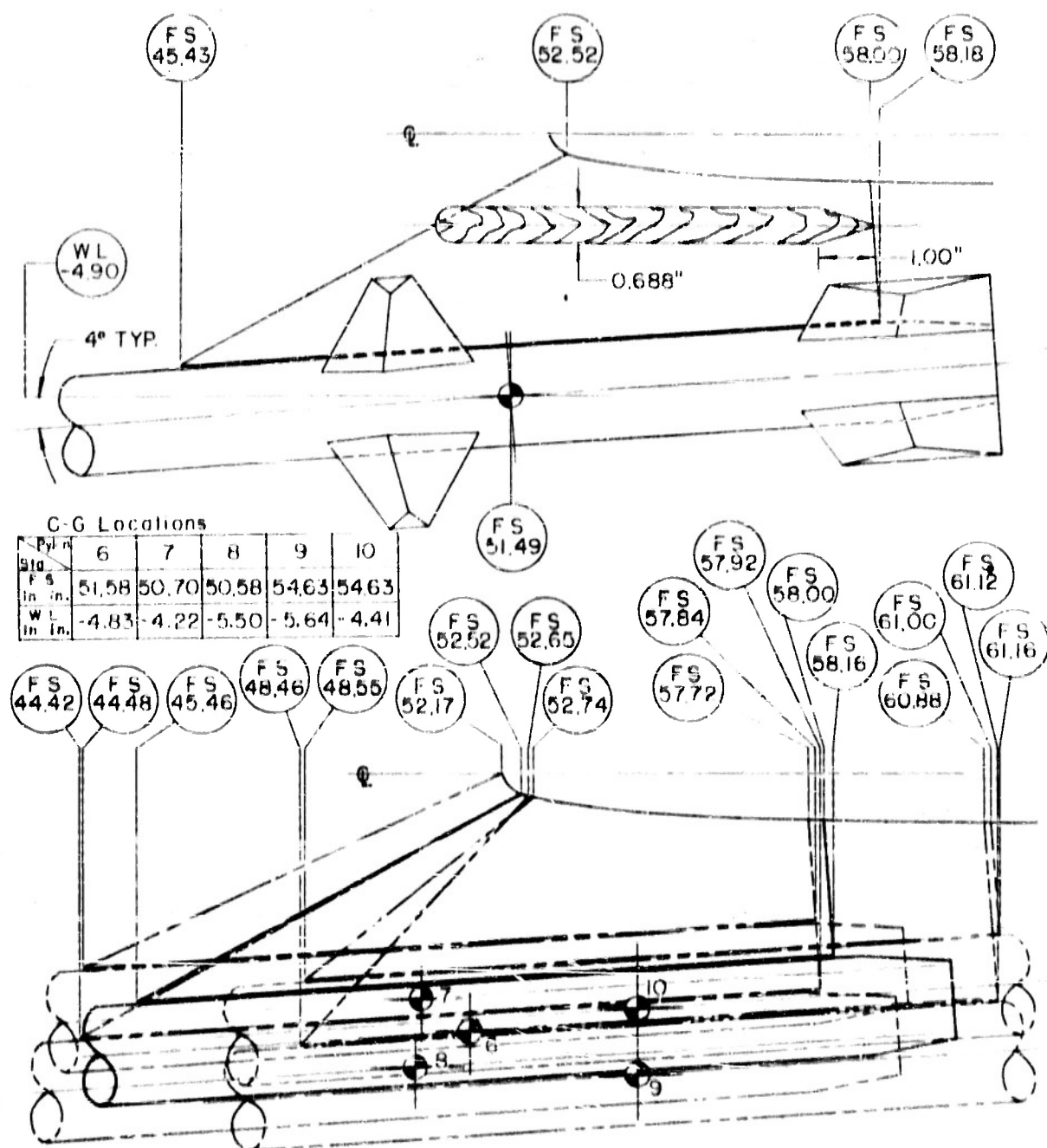


Figure 7 (Concluded)  
 (b) Outboard Station  
 (BL 22.87)

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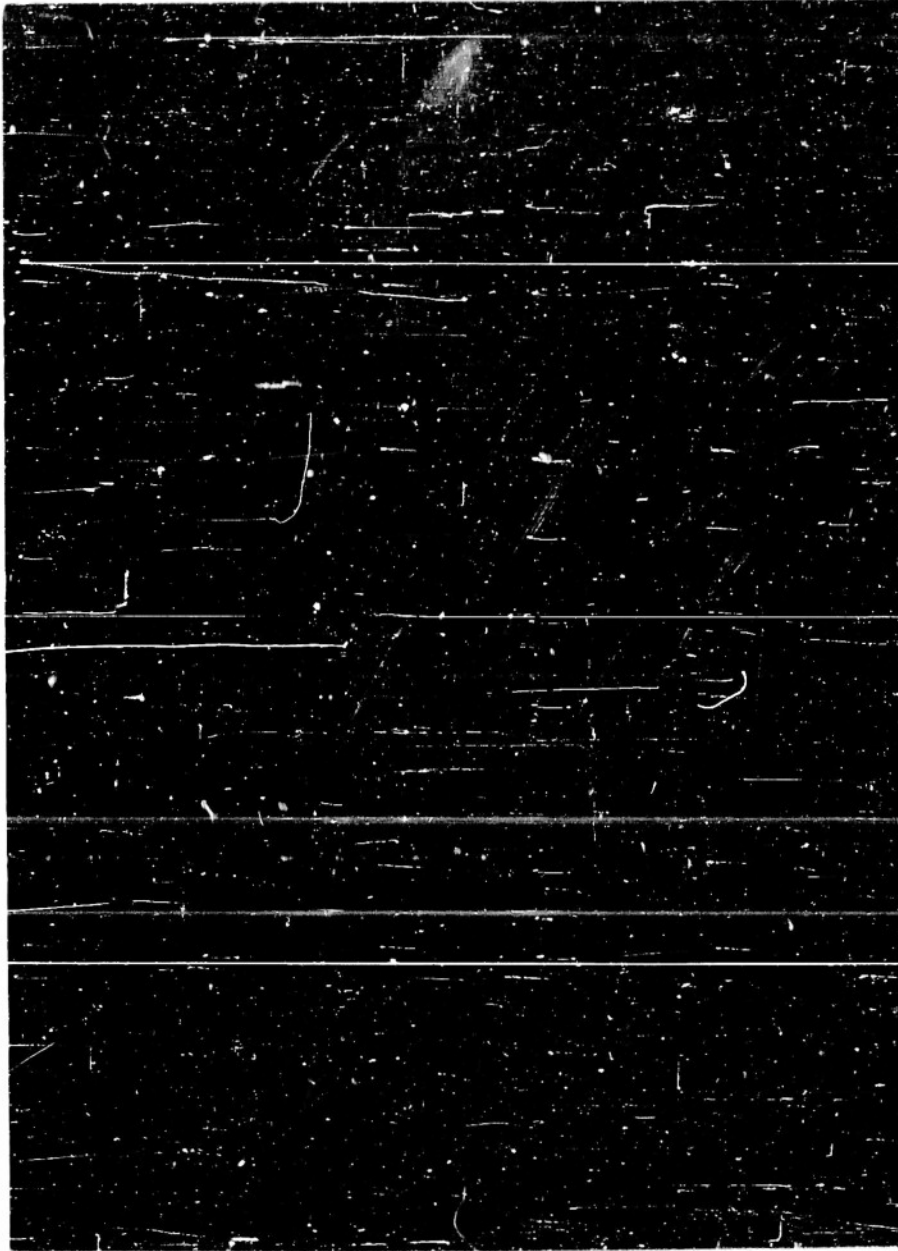


Figure 6 - View of a 0.17-Scale Model XAAX-N-4 Oriole Missile Mounted Directly to the Pylon at the Inboard Station (EL 16.26) on a 0.179-Scale Model F1D-1 Airplane Installed Inverted in the Wind Tunnel

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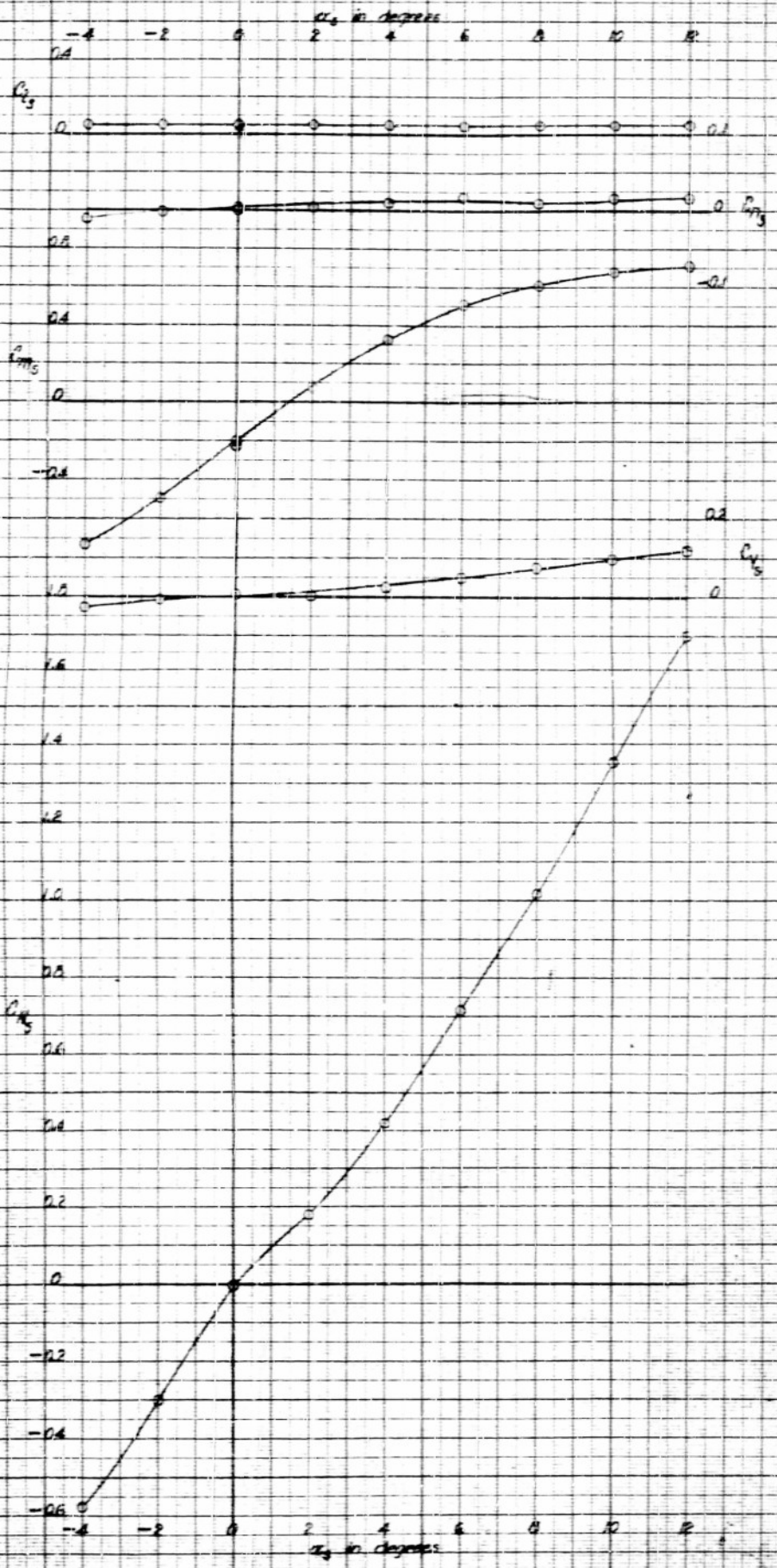
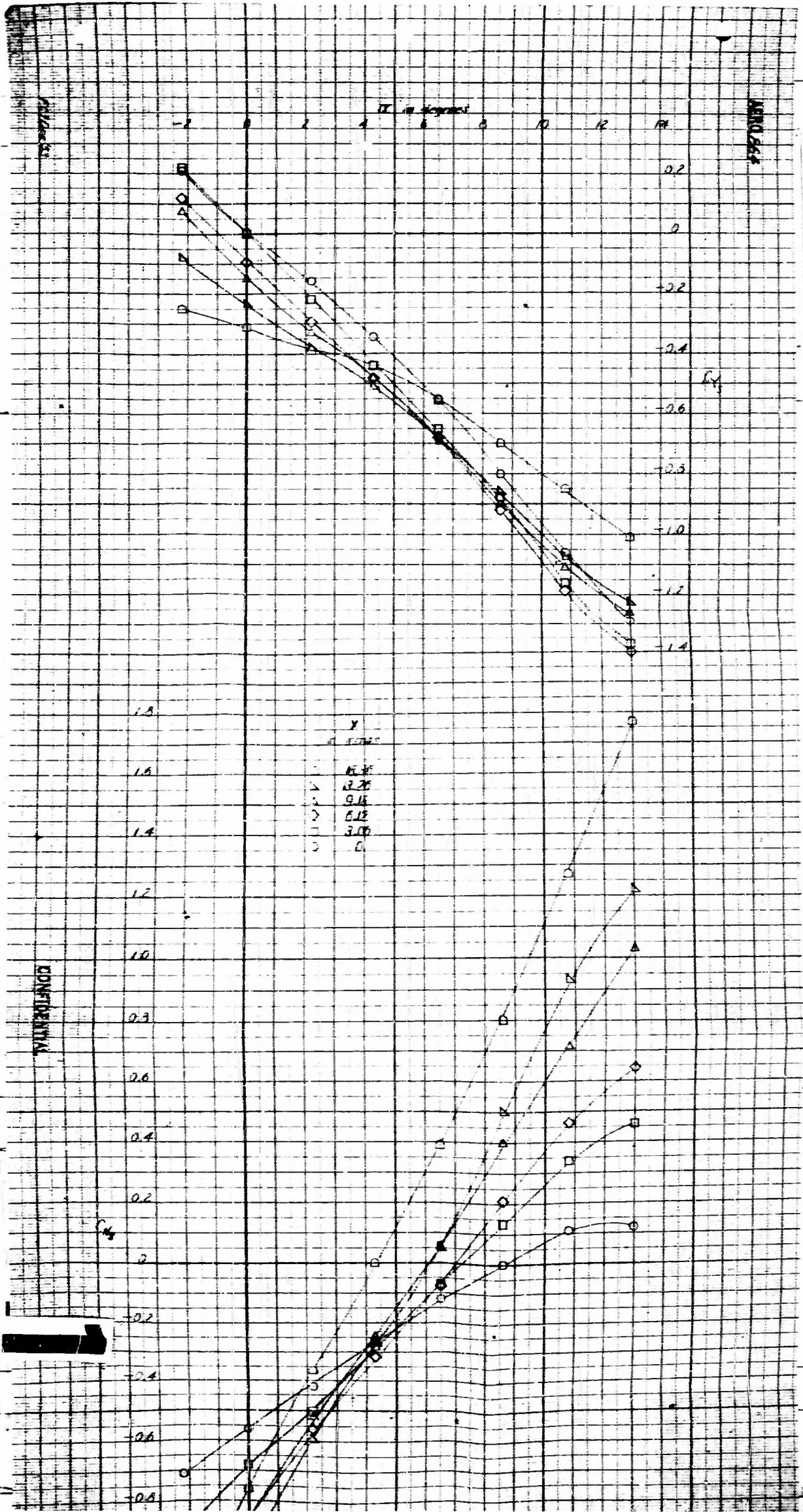


Figure 9-Aerodynamic Characteristics of a 1/12 Scale Model of the X-47B Aircraft  
 Missile Wing Mounted Along in the Wind Tunnel  
 Wing Mounted in Free Flow





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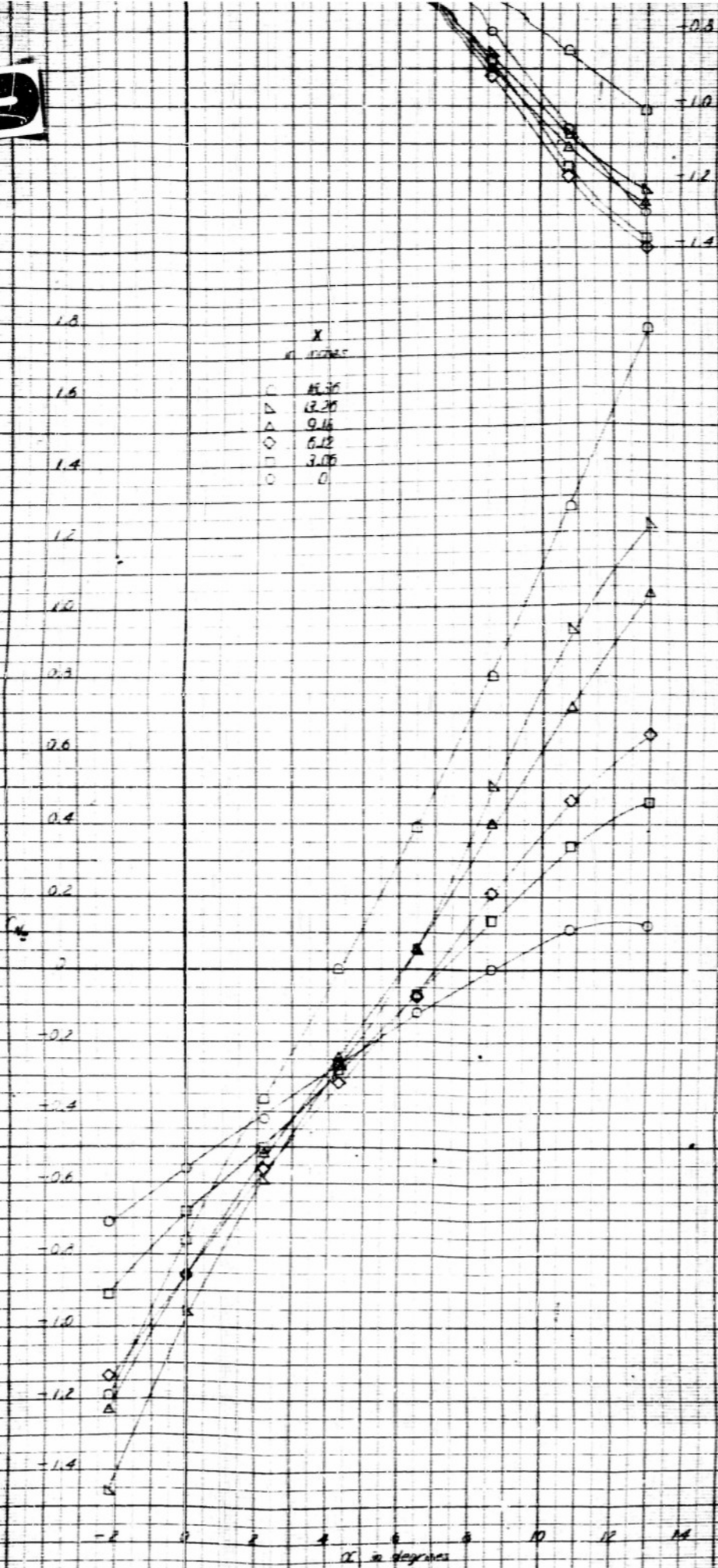
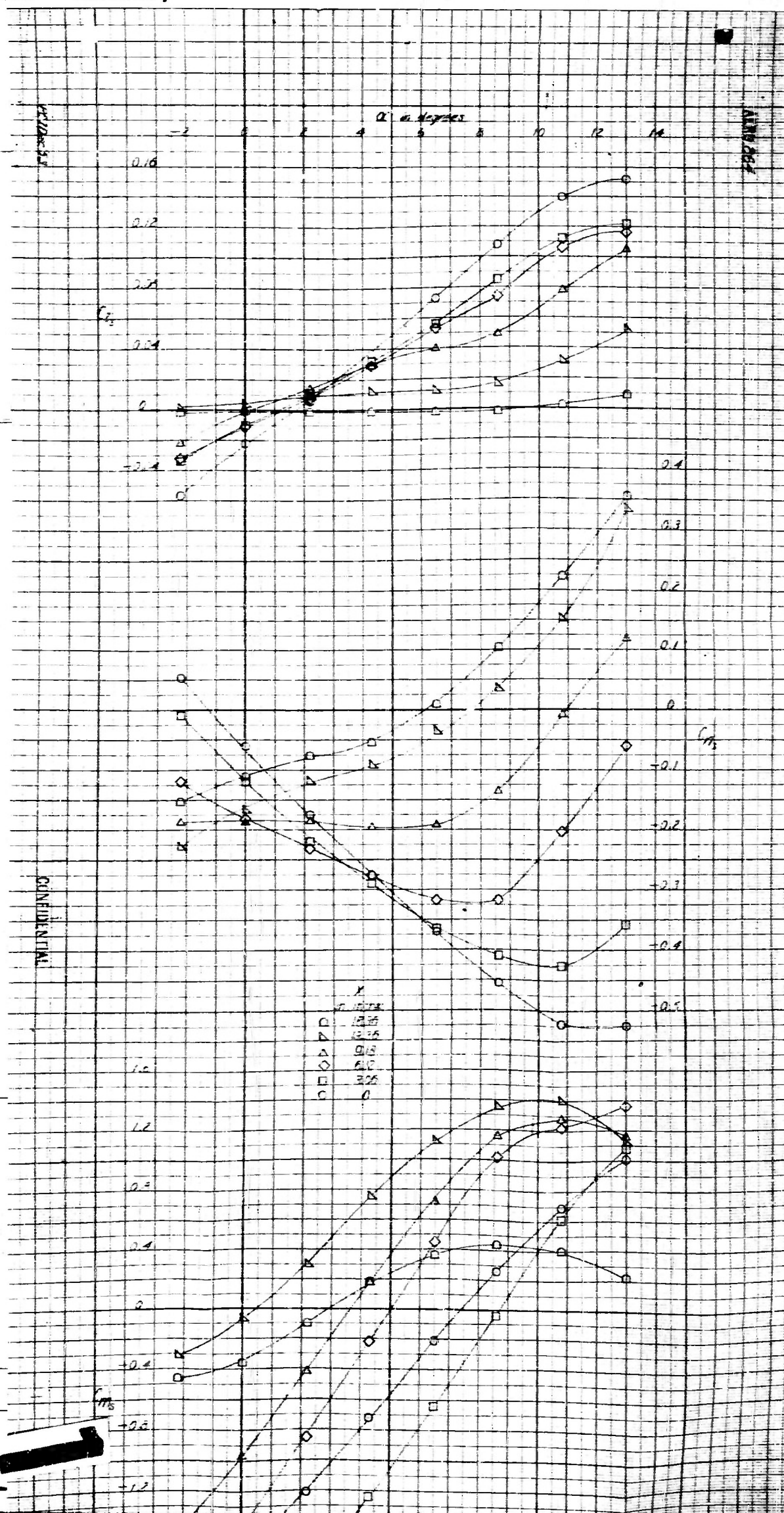


Figure 10- Aerodynamic Characteristics of a Q17-Scale Model XAAMN-6  
Cruise Missile for Various Distances Forward of the Carry  
Position in the Proximity of a Q179-Scale Model F4U-1  
Airplane at the Forward Station  
at  $\alpha = 0.172$ ,  $\beta_0 = 0^\circ$ ,  $V_0 = 0$ ,  $\delta = 0$ ,  $P_{01} = 0$

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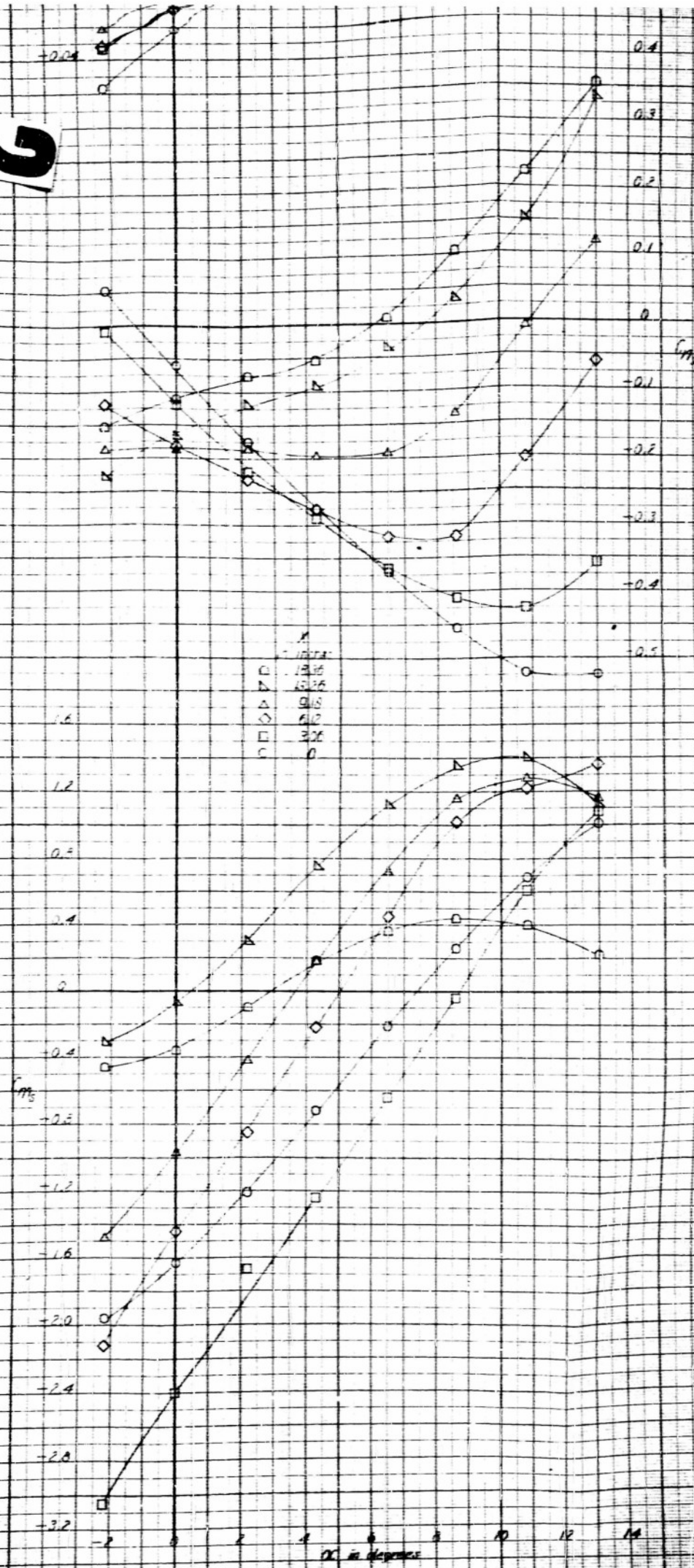
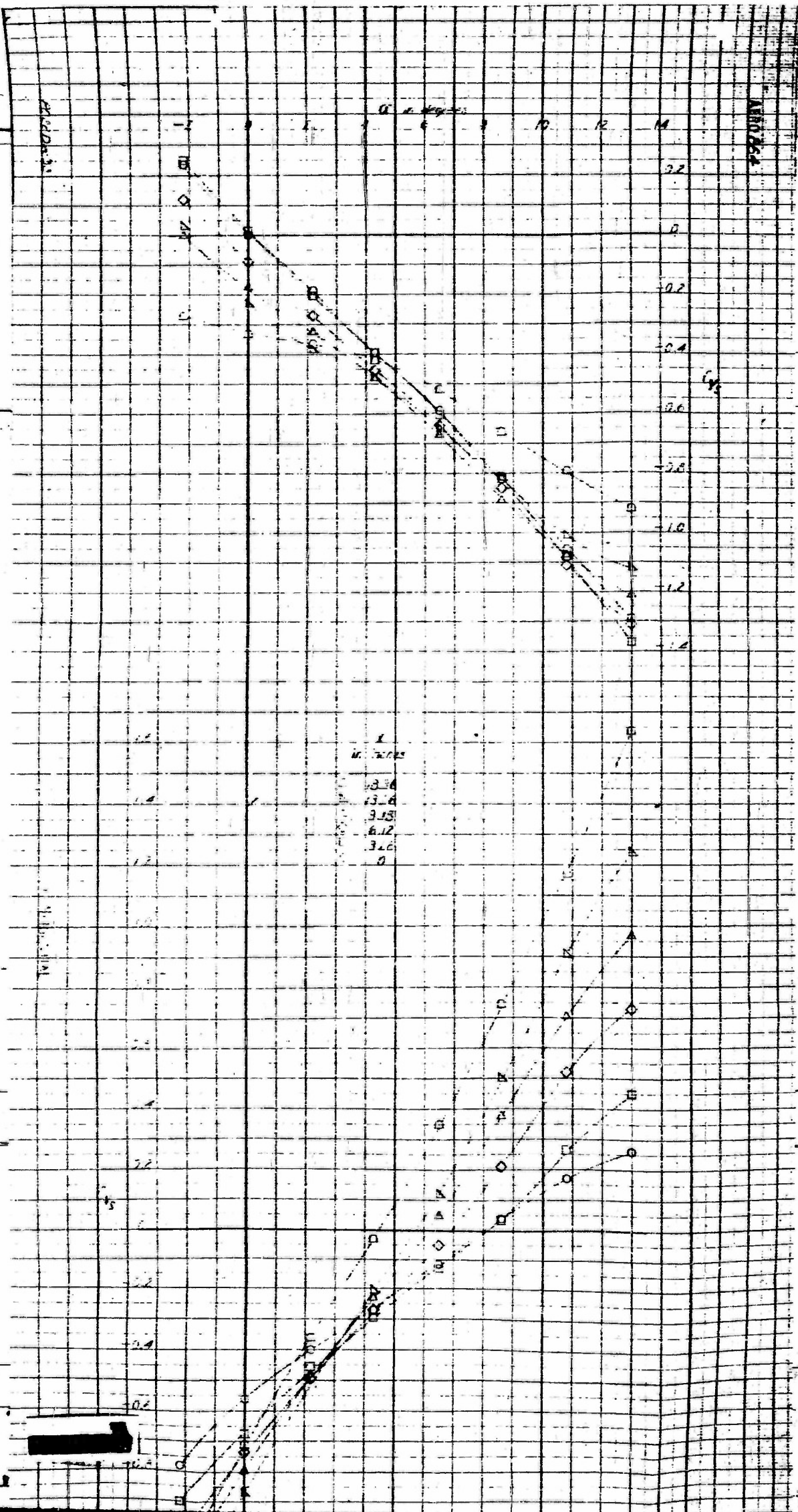


Figure 10 (Continued)  
(b) Continued

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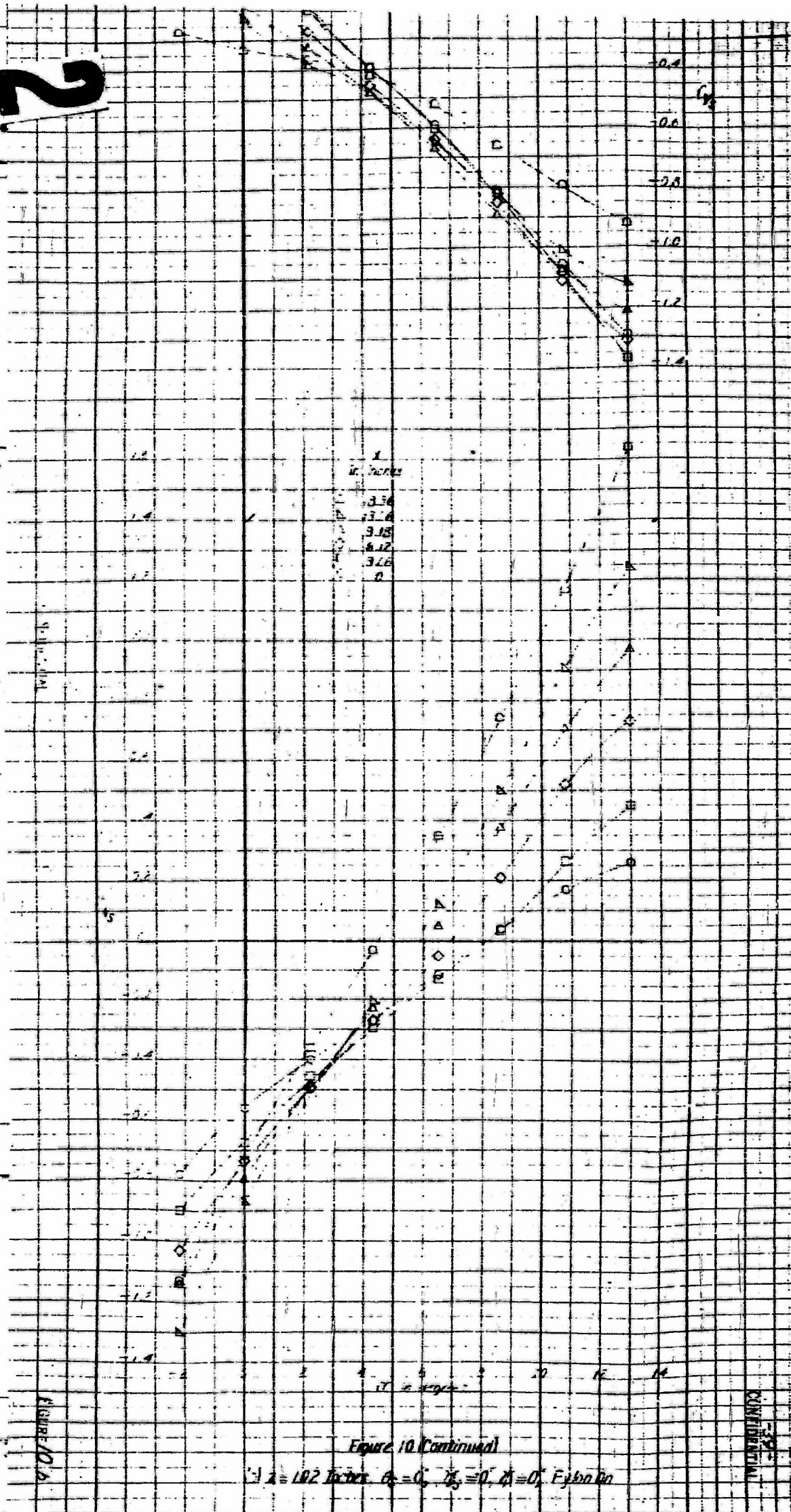


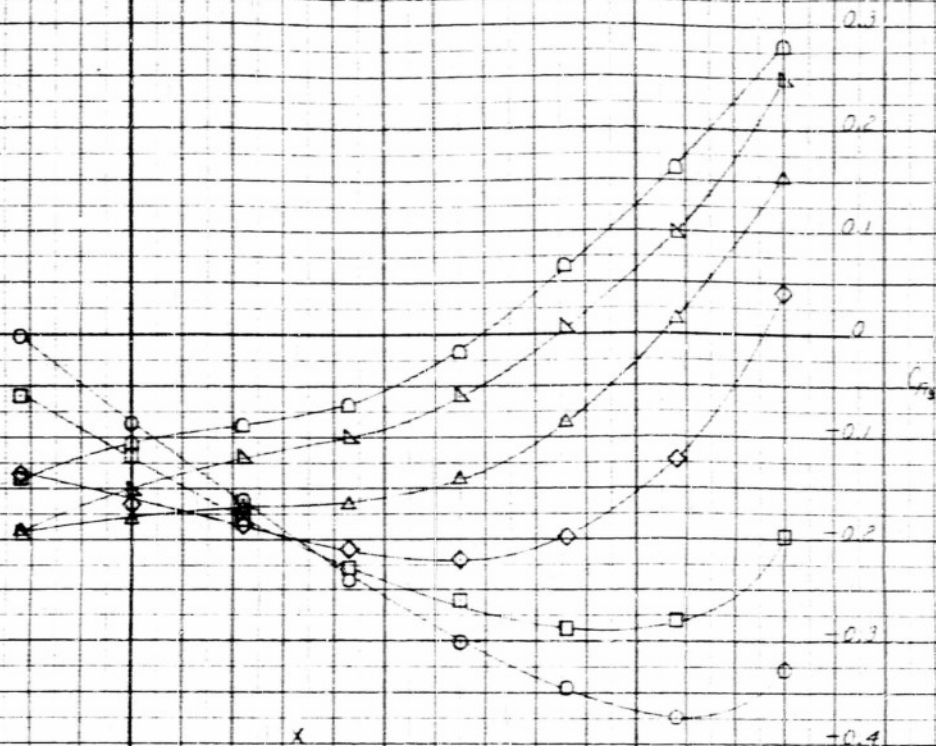
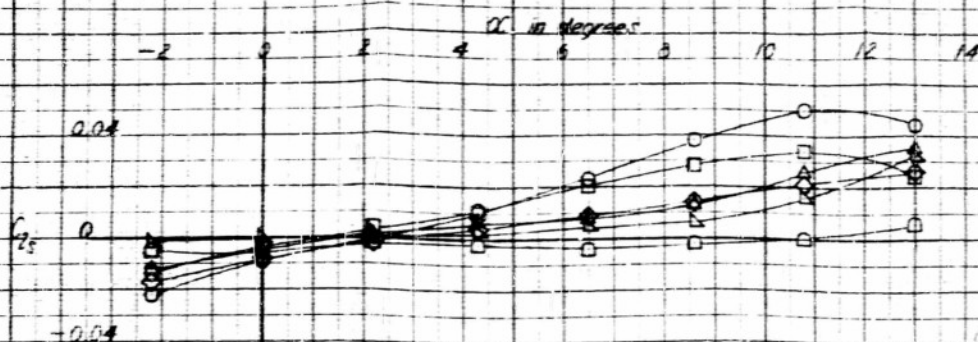
Figure 10 (Continued)

$x = 1.02$  inches,  $\theta = 0^\circ$ ,  $\gamma = 0^\circ$ ,  $\delta = 0^\circ$ ,  $F_y$  in lb

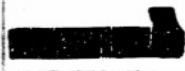
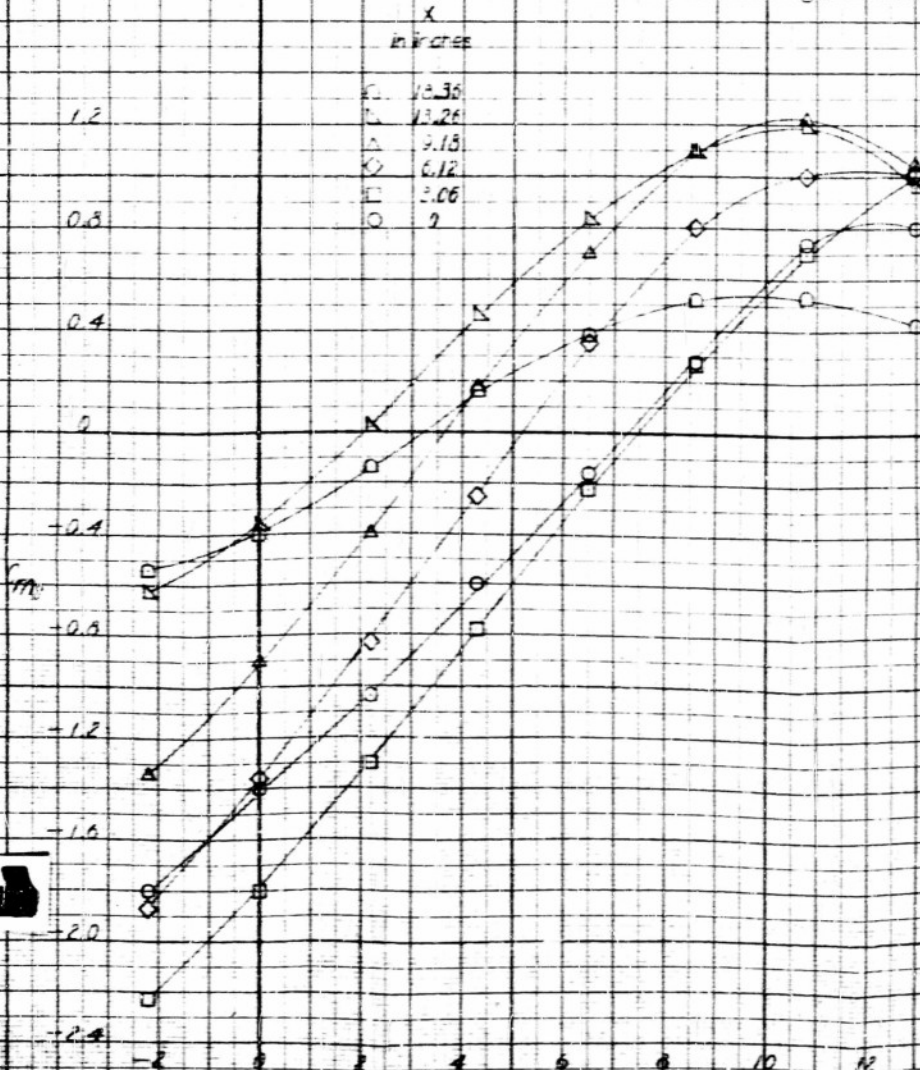
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AEJ864



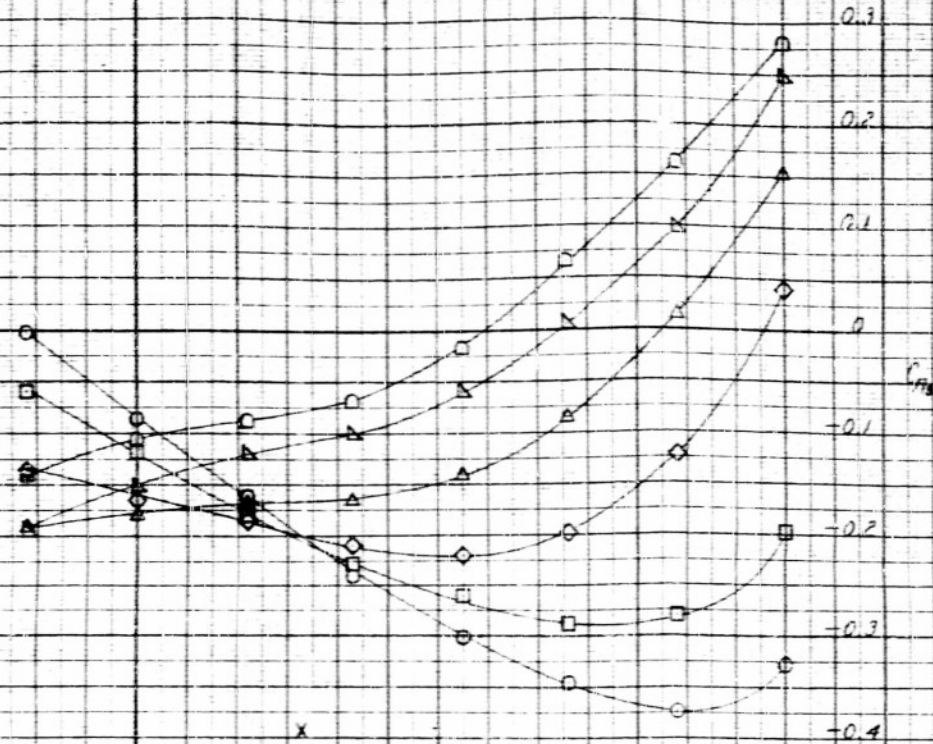
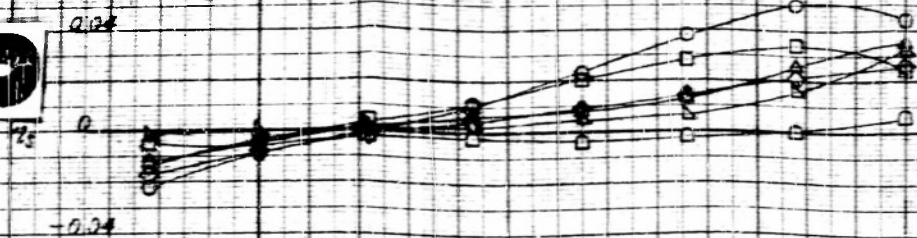
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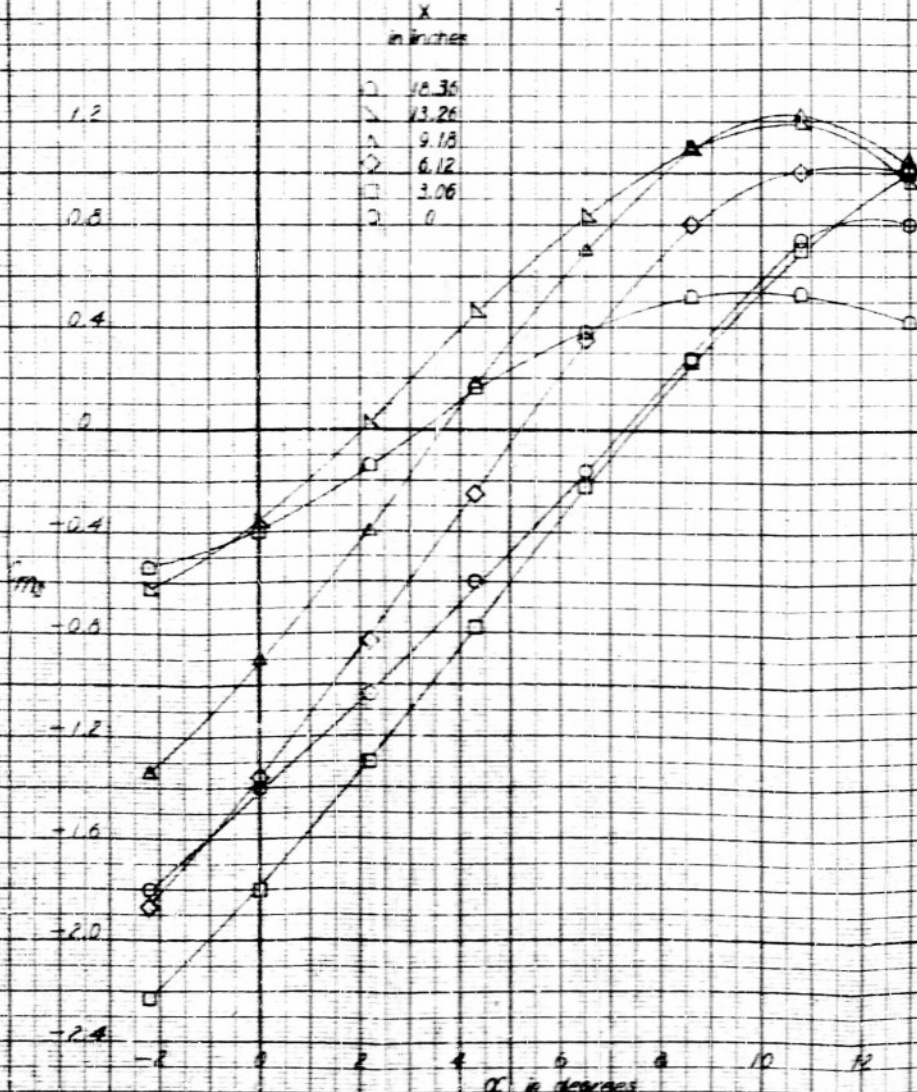


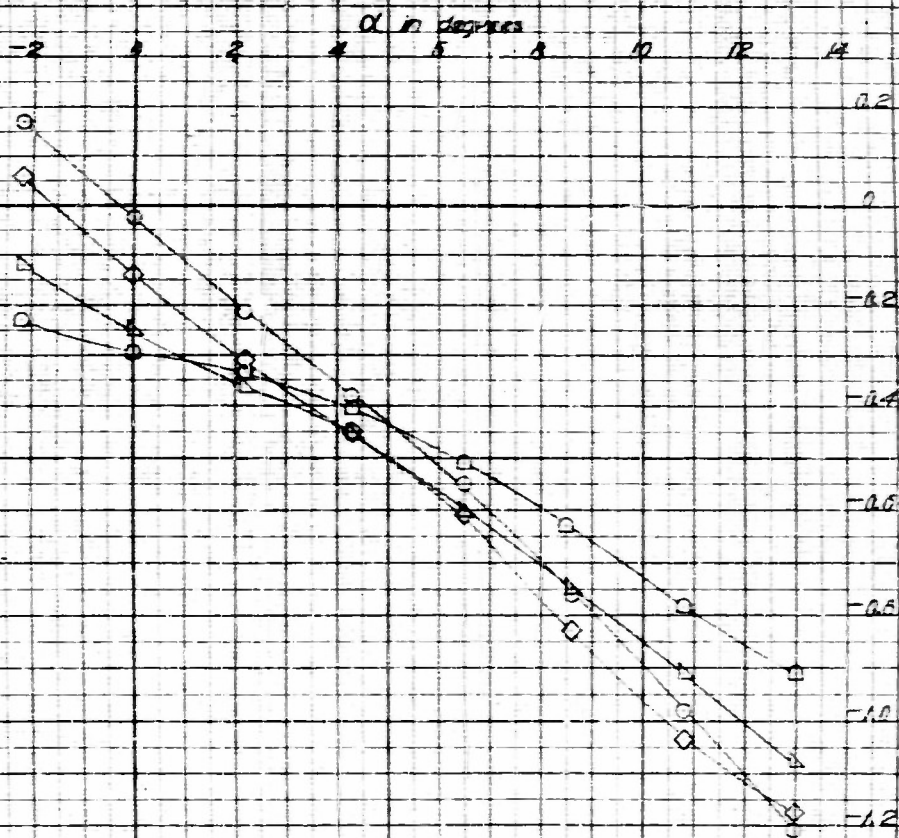
Figure 10 (Continued)  
No conclusion

Figure 10 (Continued)

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FB/DO-53

AERO 367



1.4

1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

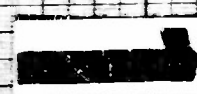
-0.4

-0.6

$x$   
in inches  
 □ 13.36  
 △ 13.25  
 ◇ 13.12  
 ○ 0

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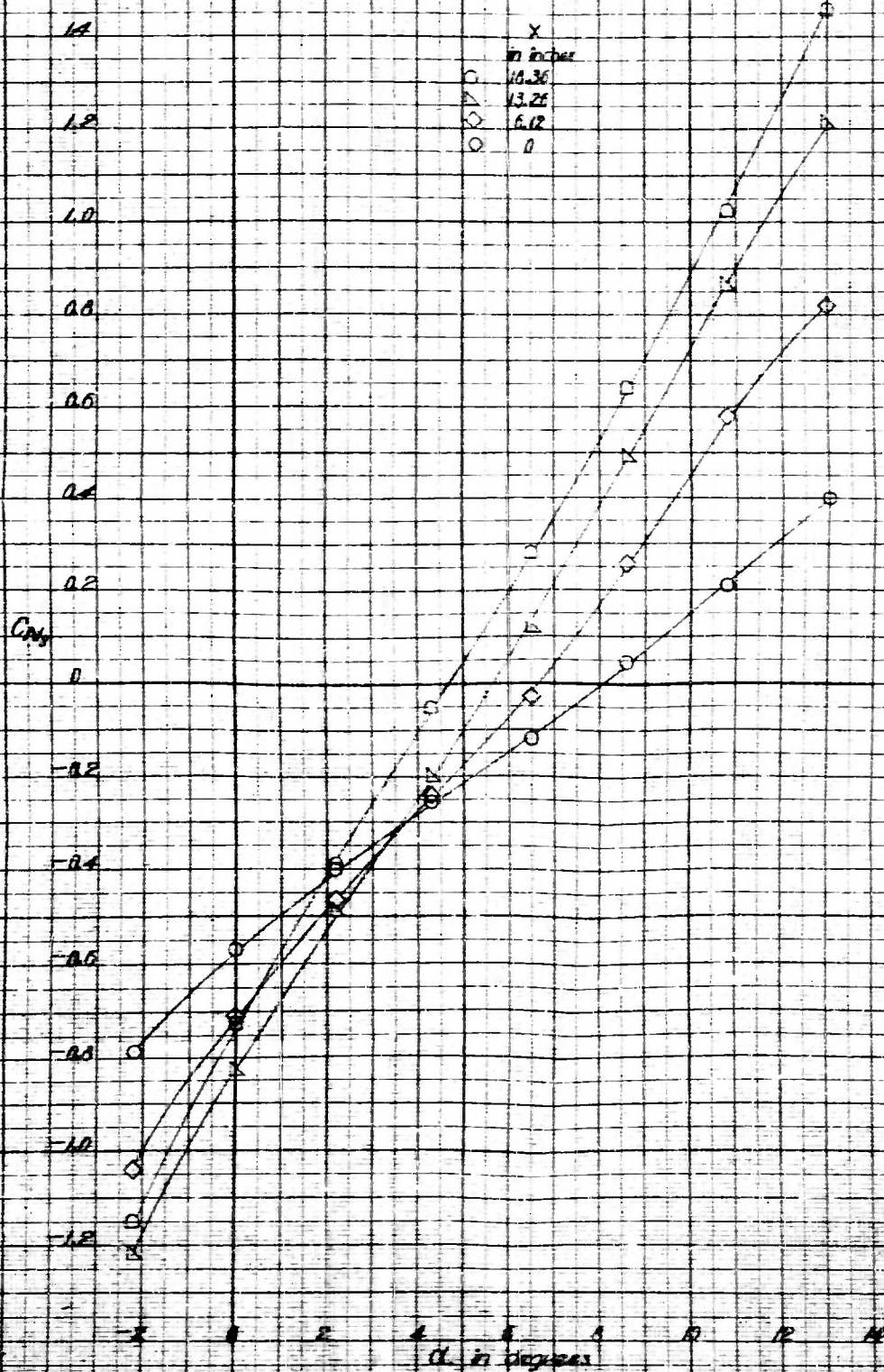
$C_M$





2

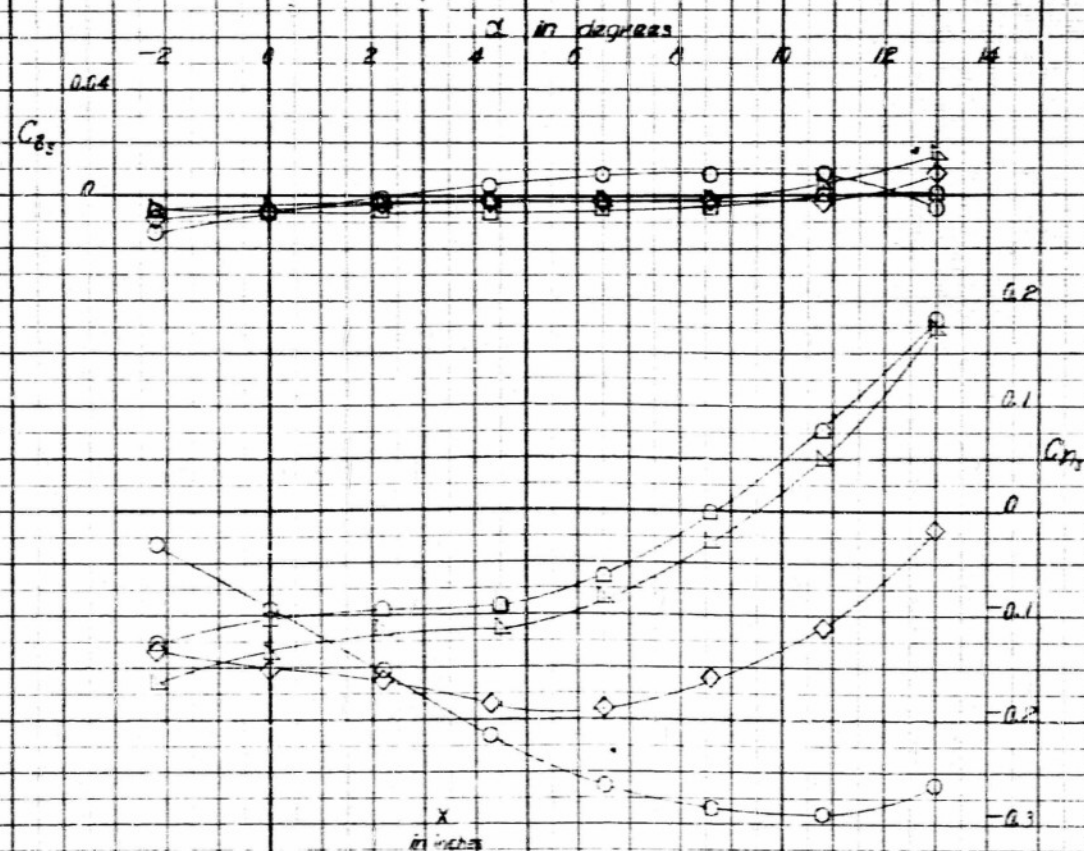
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AEBC 564



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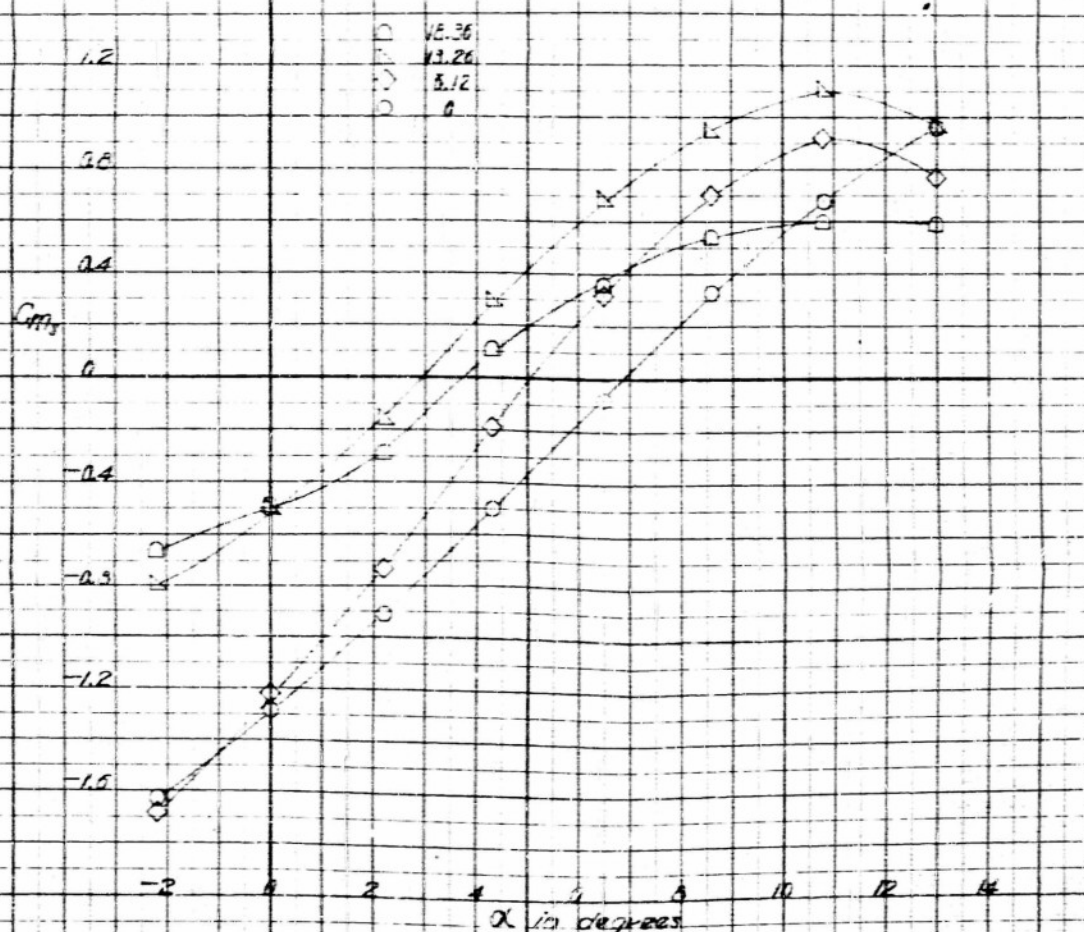


FIGURE 10 (Concluded)

Figure 10 (Concluded)  
(c) Concluded

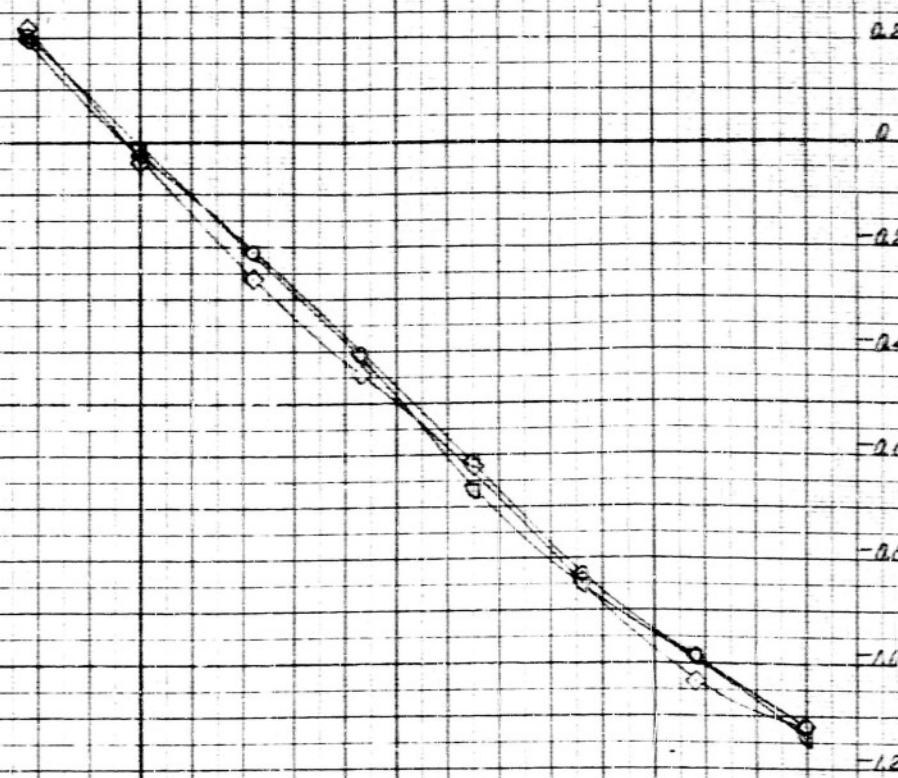
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Fig. 21 Data 13

AERO 804

$\alpha$  in degrees



1.6

1.4

1.2

1.0

0.8

0.6

$C_N$

0.4

0.2

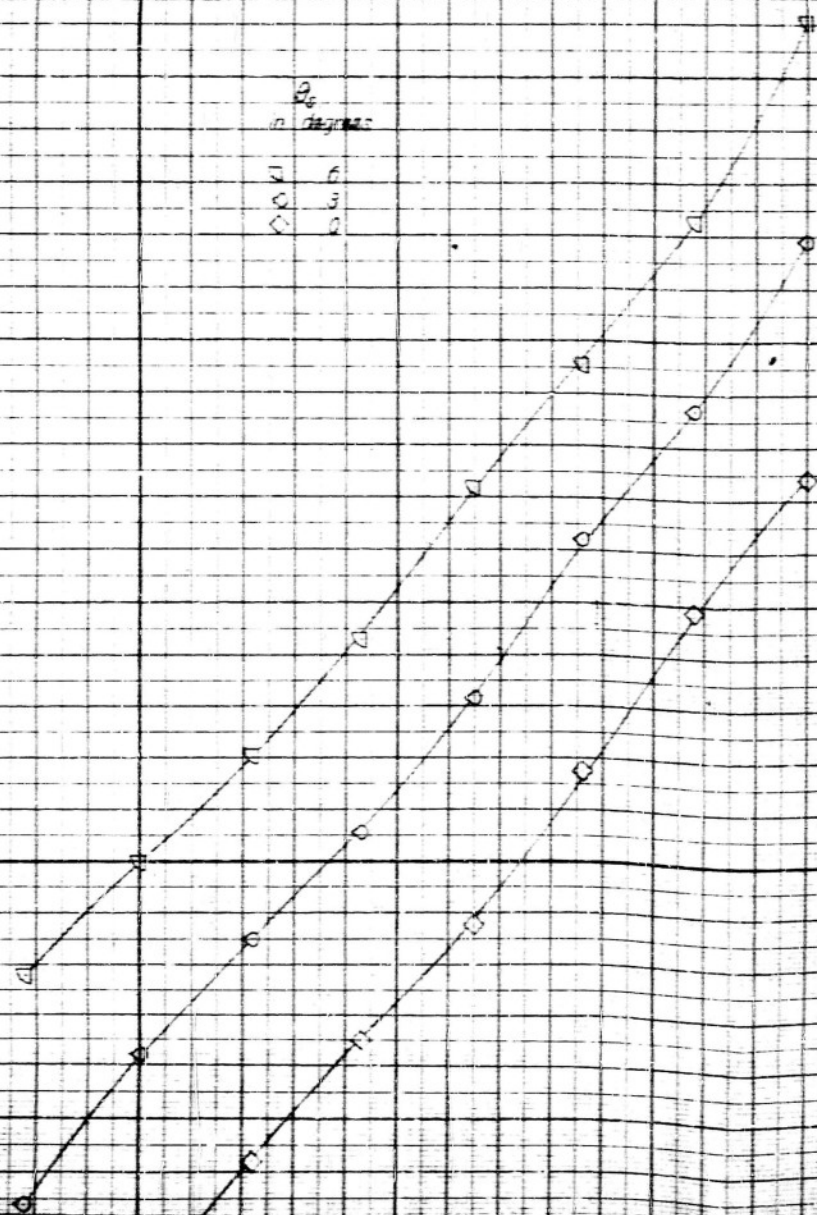
0

-0.2

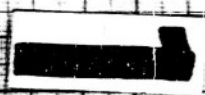
-0.4

-0.6

$\beta$  in degrees  
 6  
 3  
 0



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2

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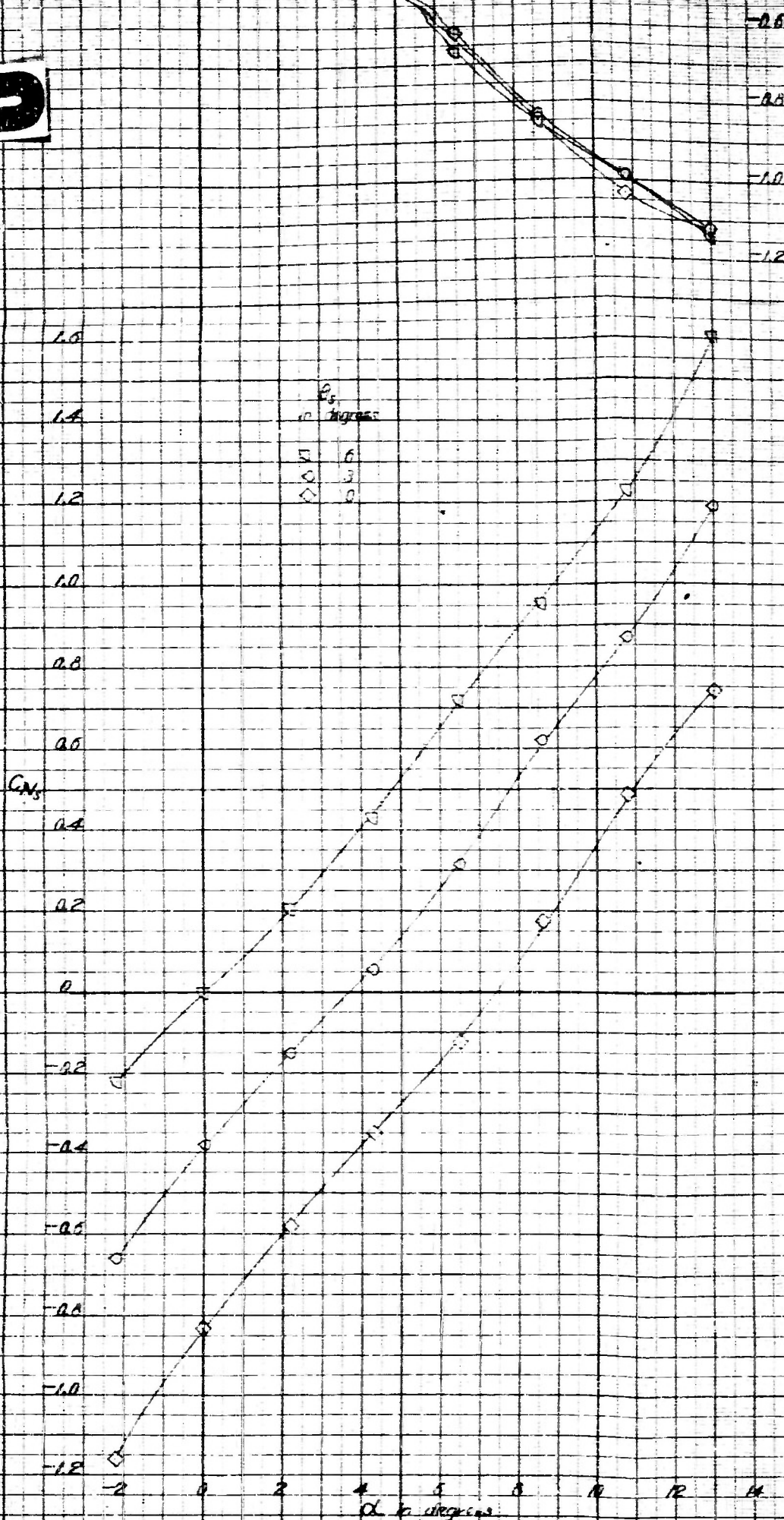


Figure 11 - Aerodynamic Characteristics of a 0.7-Scale Model  
 XRAM-N-4 Cruise Missile Due to Missile Pitch in the  
 Proximity of a 0.79-Scale Model F4D-1 Airplane  
 at the Johnson Station  
 (a)  $z = 0$  inch,  $x = 612$  inches,  $M_\infty = 0.75$ ,  $Re = 1.5 \times 10^6$

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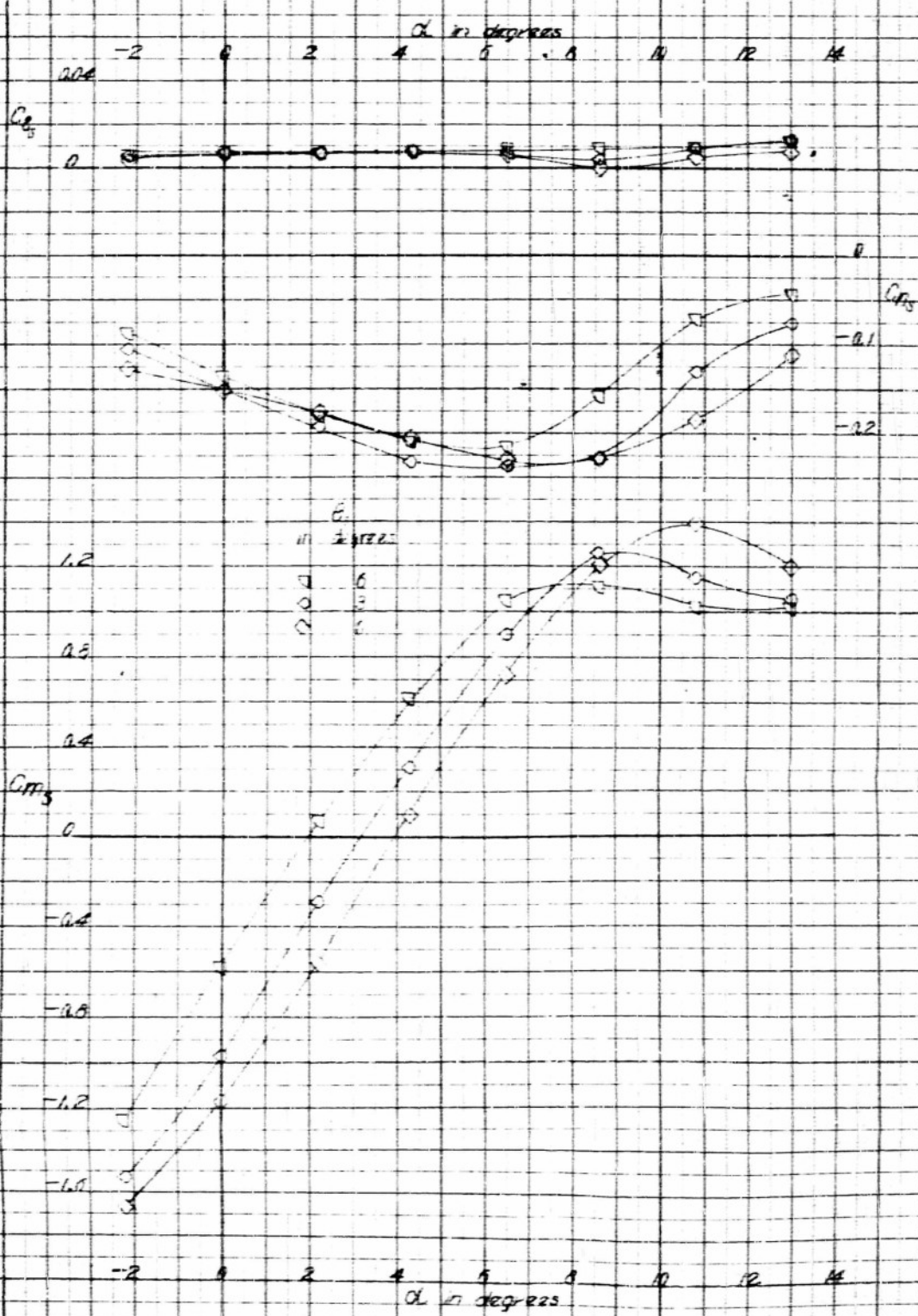
ER 2/ Dec 53

AERO 604

CONFIDENTIAL

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FIGURE 10 (Contd.)



Figures 10 (Contd.)  
(a) 5.0 inches

PROBES

AERO 554

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2  
-1.4

$C_{L\alpha}$

1.5  
1.6  
1.4  
1.2  
1.0  
0.8  
0.6  
0.4  
0.2  
0

$\beta$   
in degrees

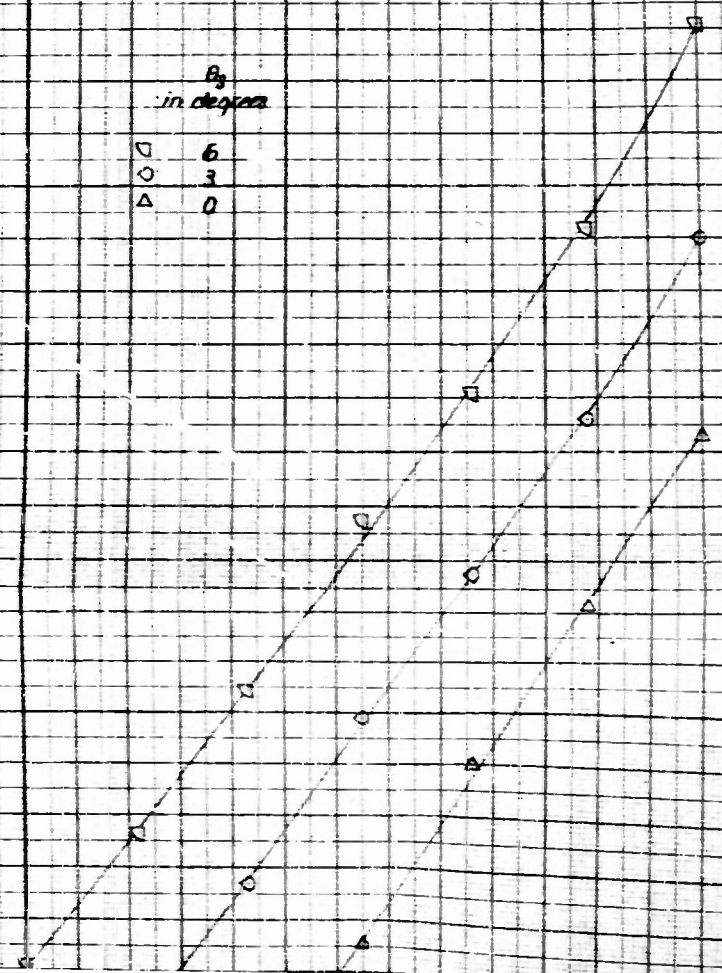
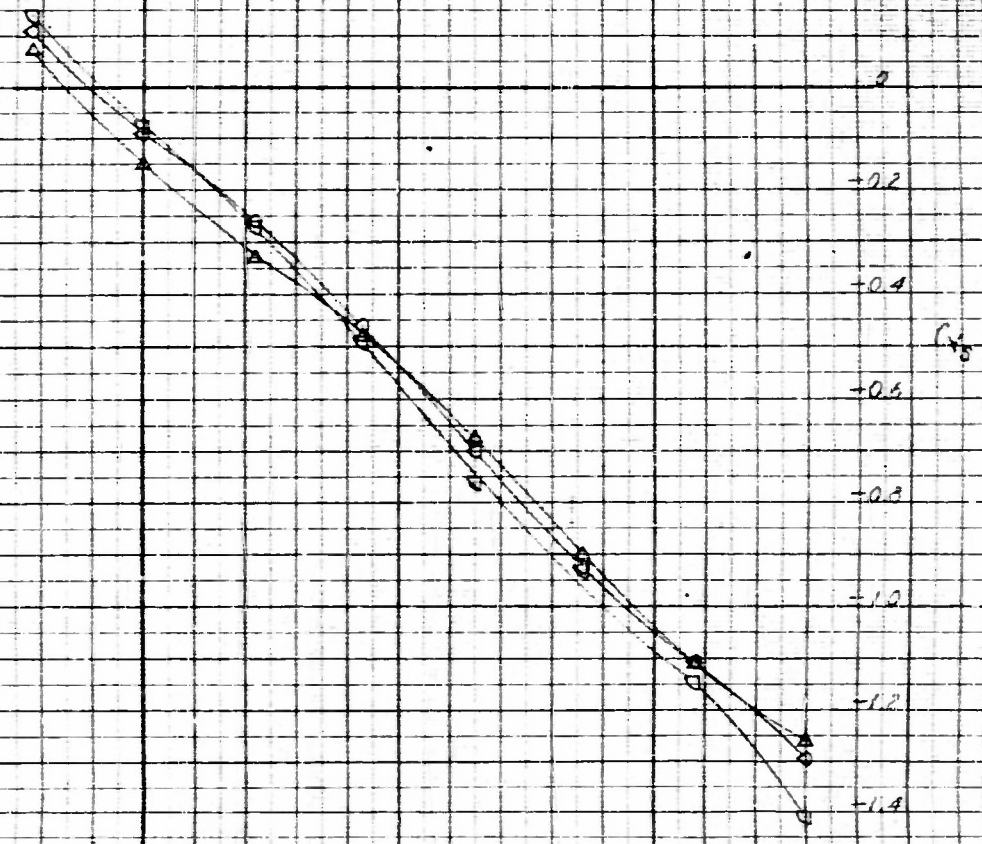
$\square$  6  
 $\circ$  3  
 $\triangle$  0

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$C_M$

0.2

0





2

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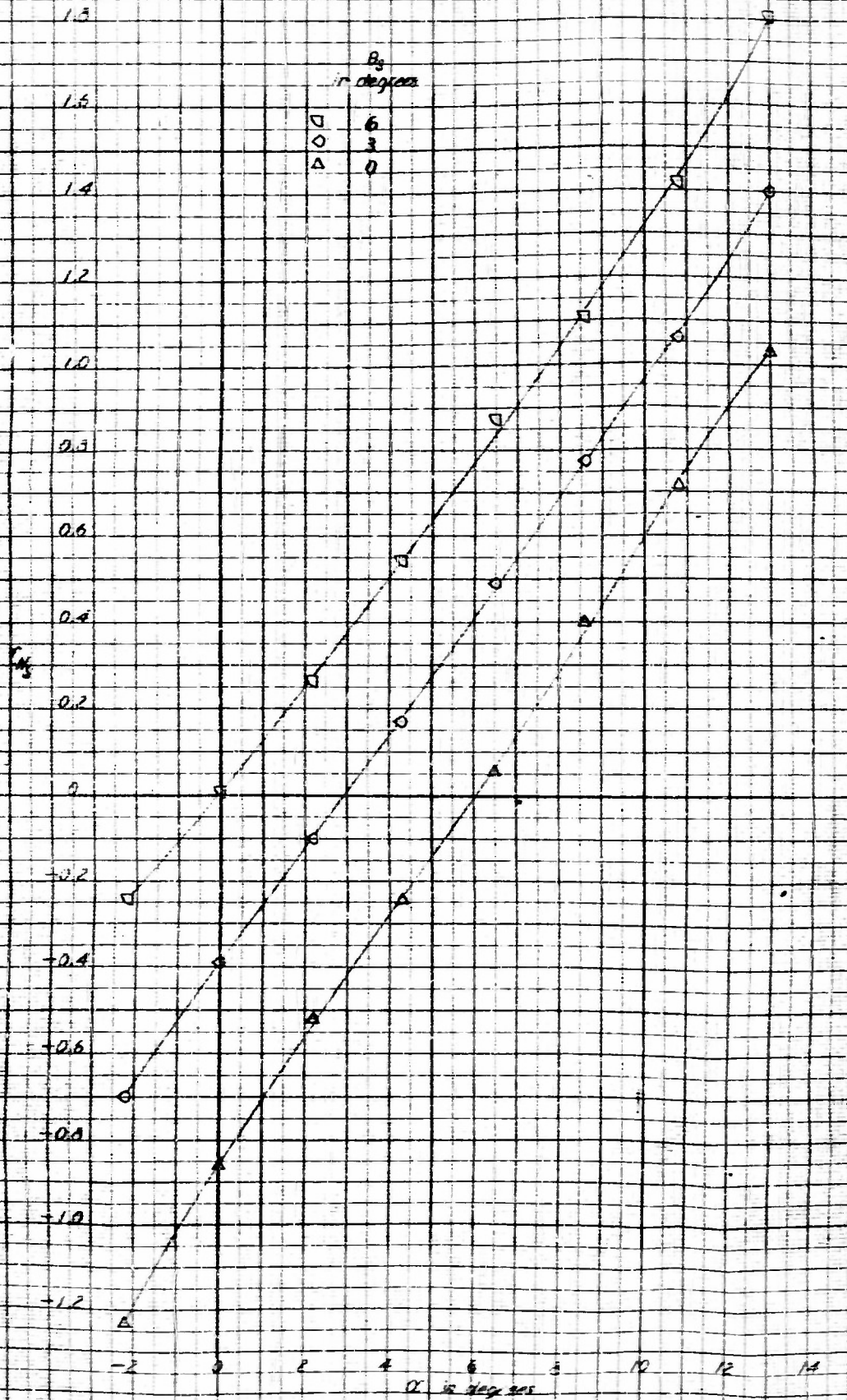


FIGURE 11

Figure 11 (Continued)

(b)  $z = 0.1$  inch,  $x = 9.13$  inches,  $\beta_3 = 0^\circ$ ,  $\beta_4 = 0^\circ$ ,  $\beta_5 = 0^\circ$

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11/10/54

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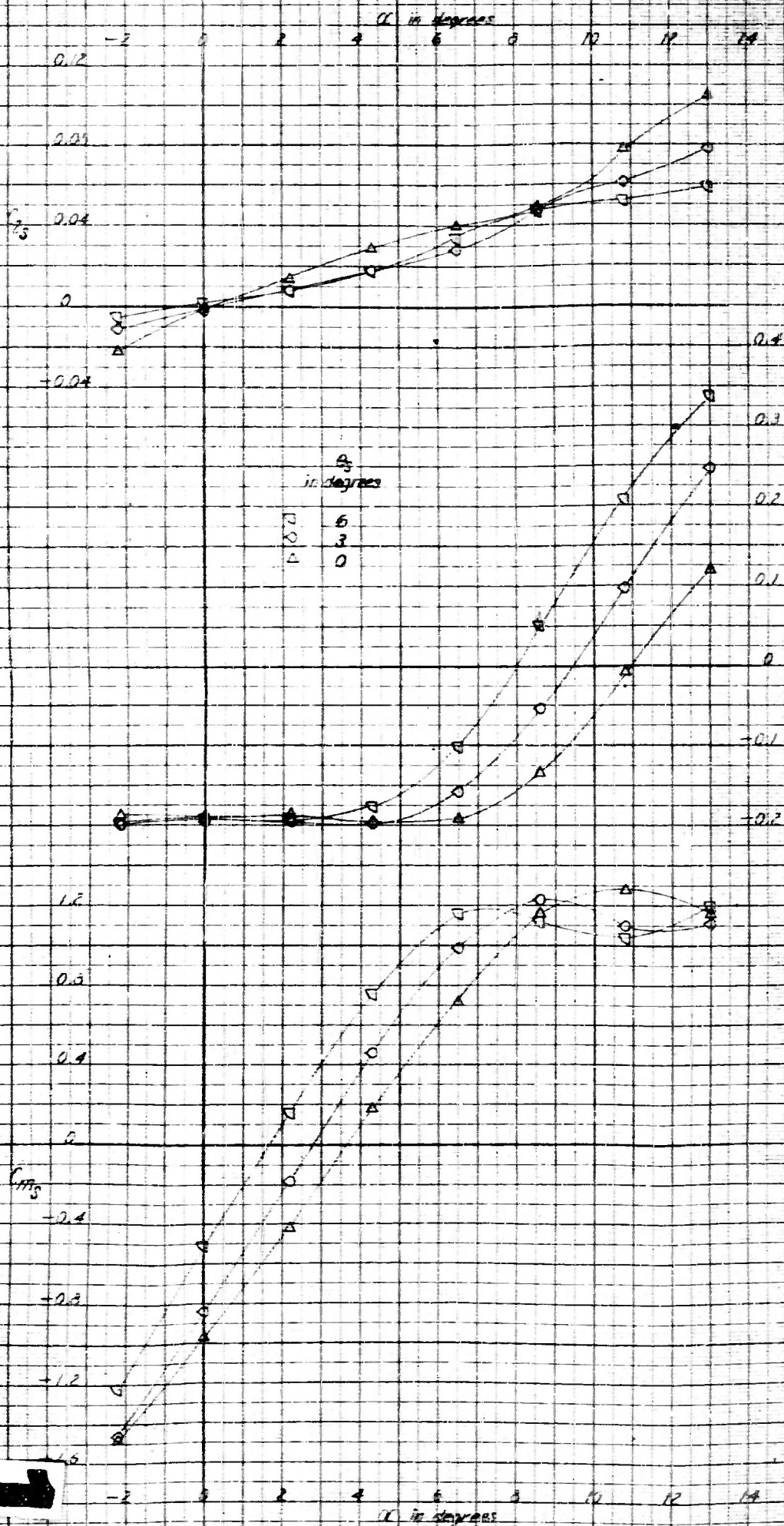


Figure 11 (Continued)

to be continued

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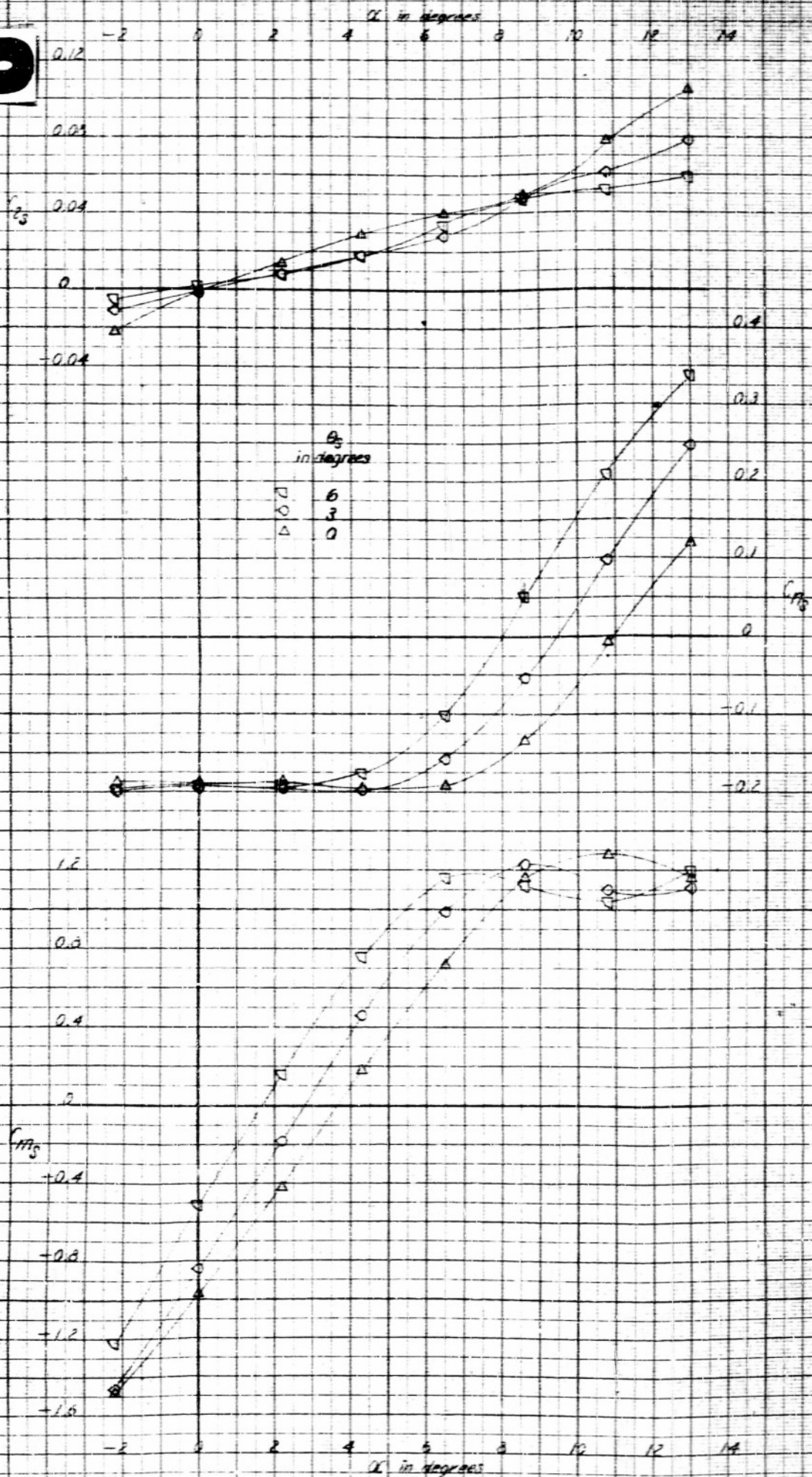


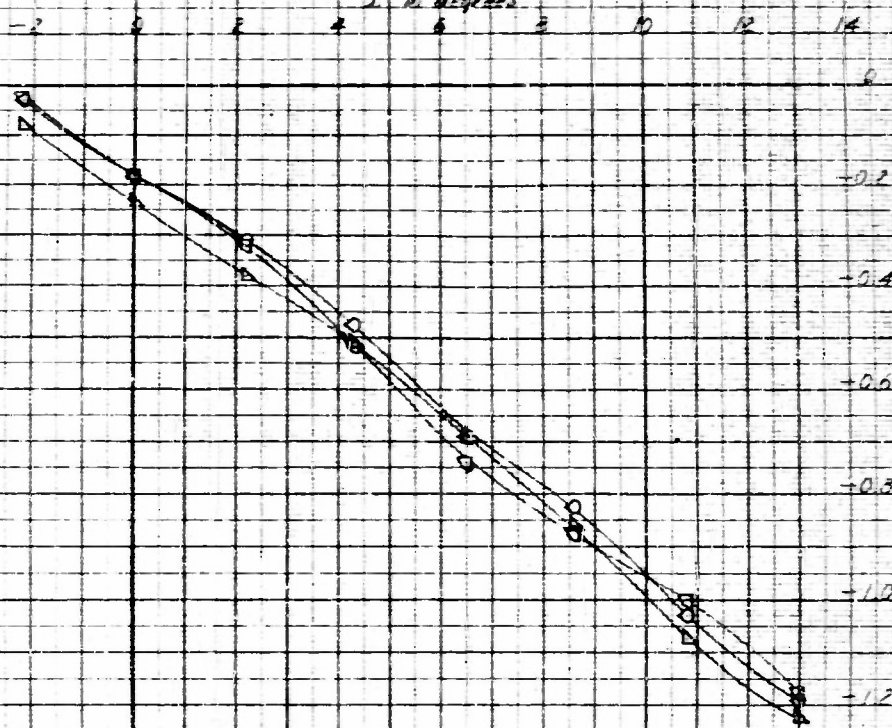
Figure 11 (Continued)  
1b) Concluded

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PERFORMANCE

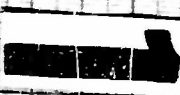
AEROBIC

$\gamma$  in degrees



$\alpha$   
in degrees  
 $\square \square \square$  6  
 $\square \square \square$  3  
 $\square \square \square$  0

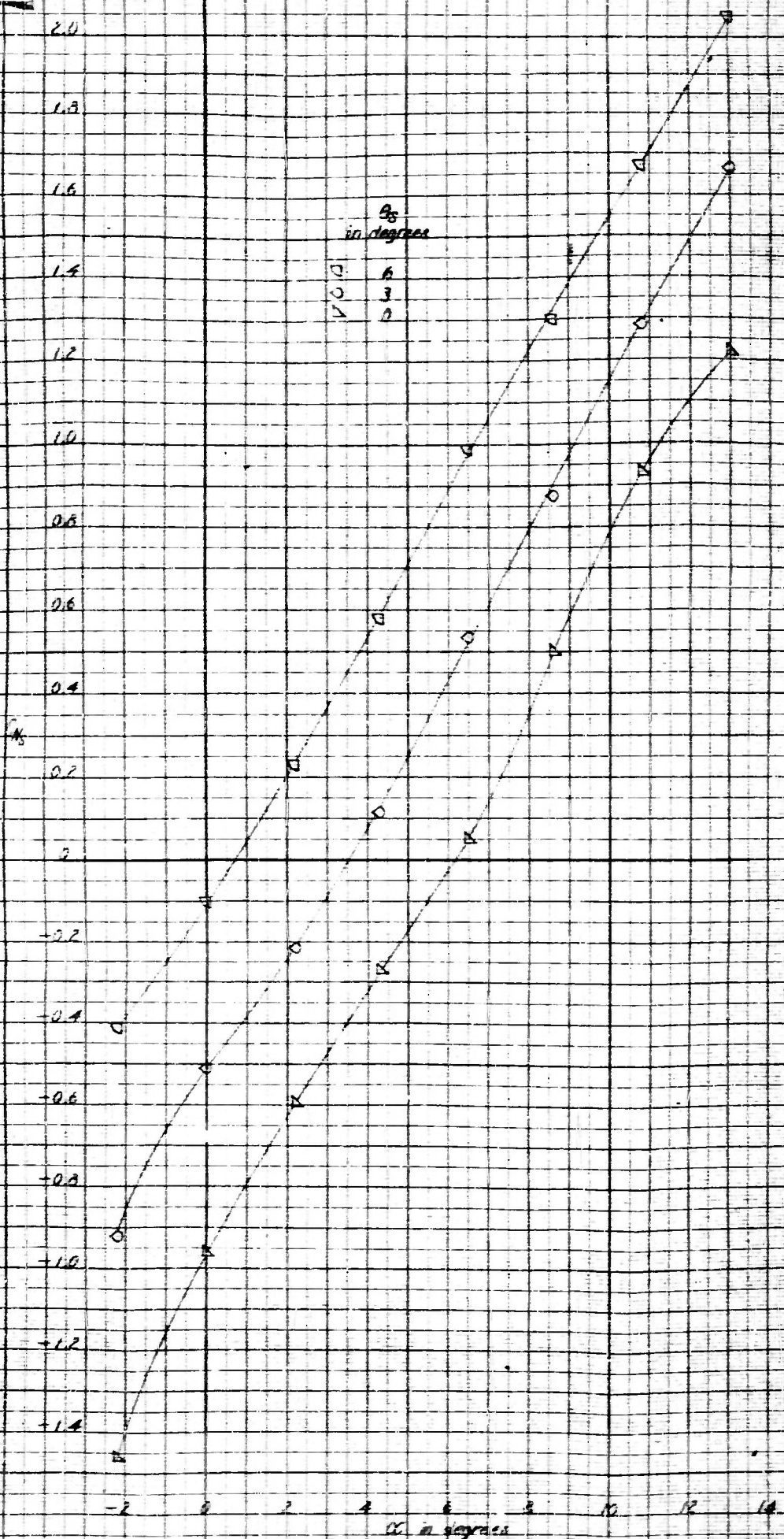
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$\theta_0$   
in degrees  
D O A  
6 3 0

Figure 11 (Continued)

(c)  $z = 0$  inch,  $x = 13.26$  inches,  $\theta_0 = 0^\circ$ ,  $\beta = 0^\circ$ ,  $P_{\text{type A}}$

FIGURE 11

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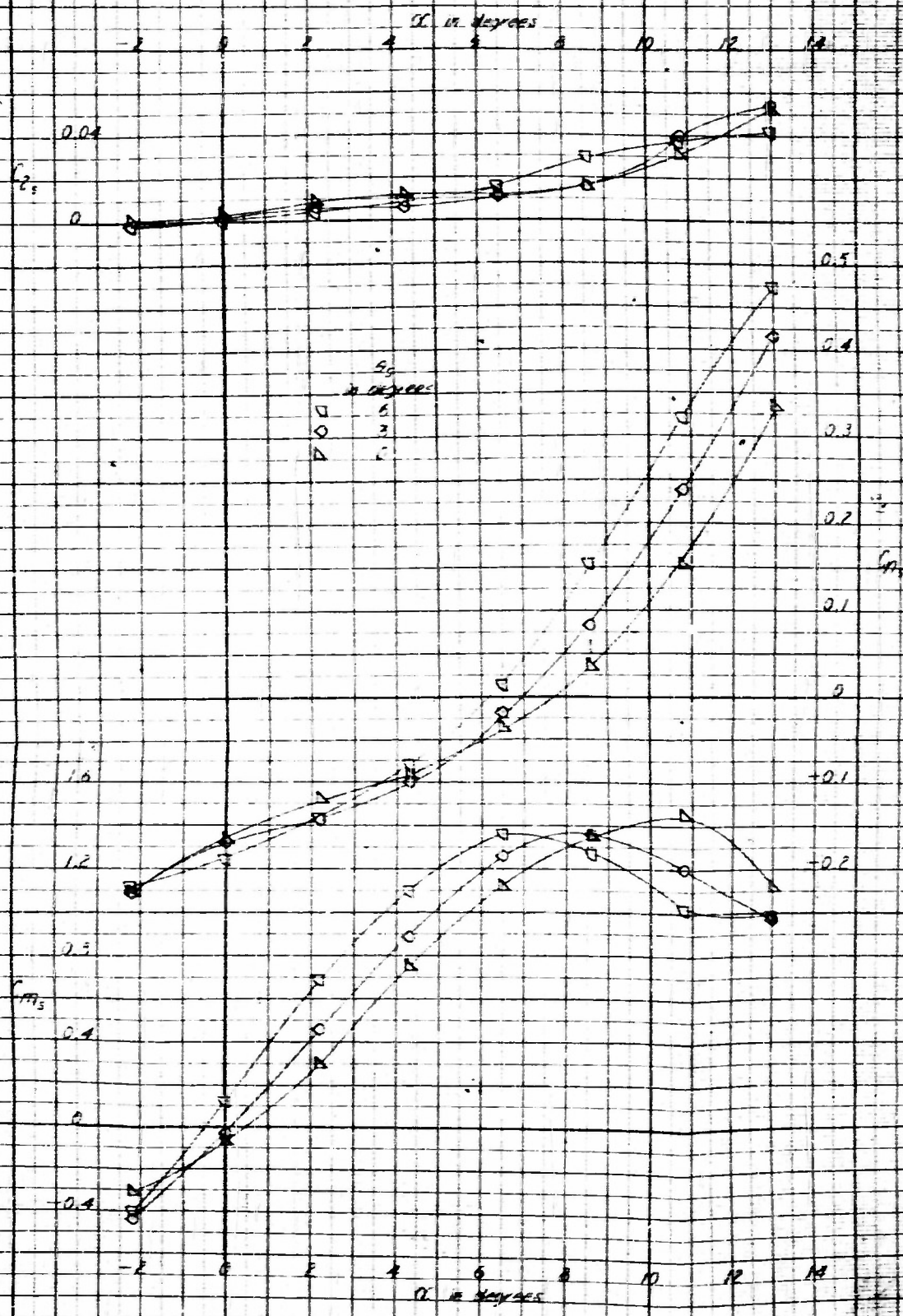


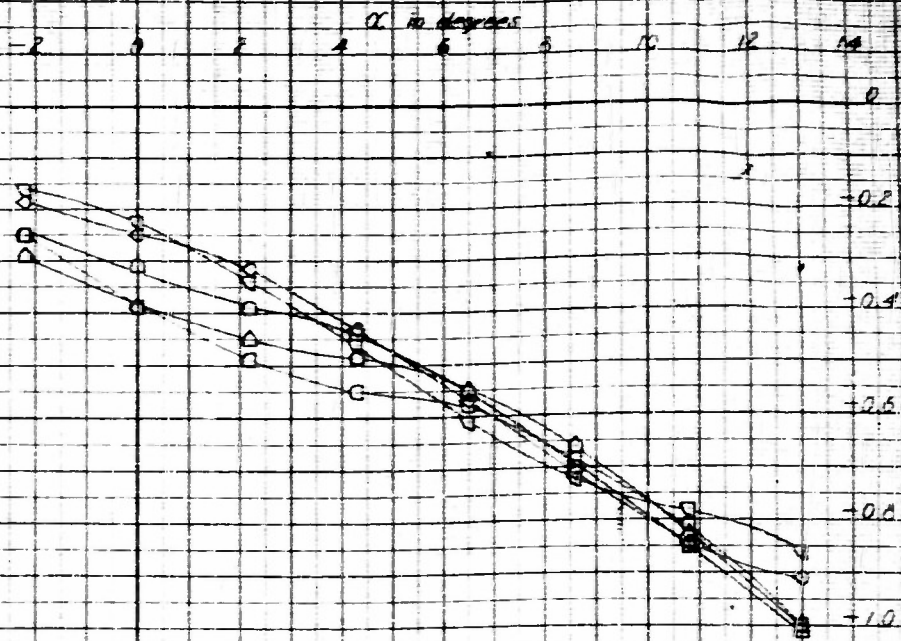
Figure 11 (Continued)  
(C) Concluded

FIGURE 11 (Continued)  
(C) Concluded



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ALM 864



2.4

2.2

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

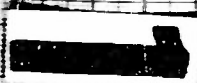
0

-0.2

$\beta$   
in degrees

$\diamond$	6
$\square$	3
$\square$	0
$\square$	-3
$\square$	-5

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2

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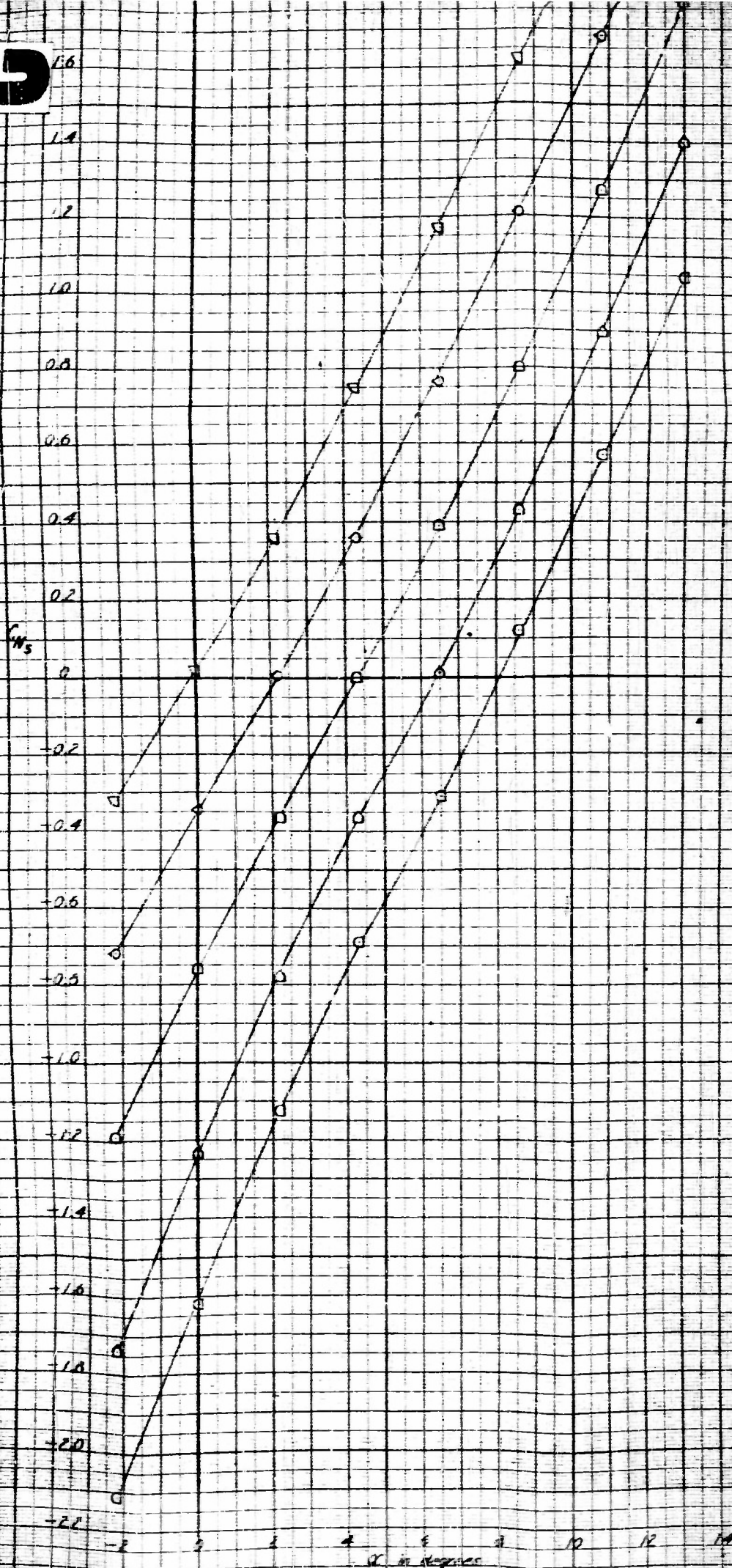


FIGURE 11 (Continued)

(c)  $z = 0$  inch,  $x = 8.34$  inches,  $y_0 = 0$ ,  $y = 11$ ,  $z = 0$  inch

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AERO 864

14-9800137

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FIGURE 11 (Continued)

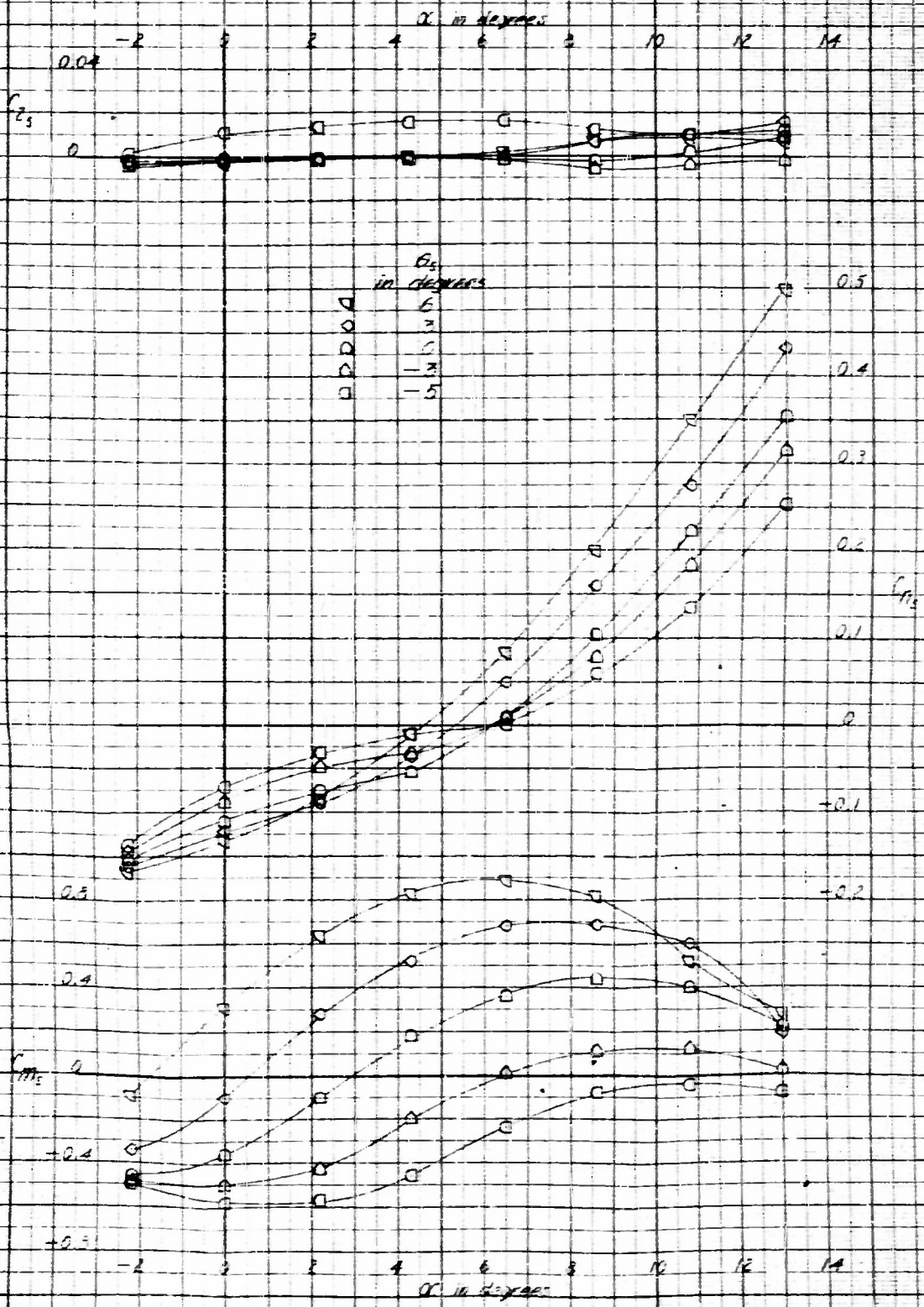


Figure 11 (Continued)

(a) Continued

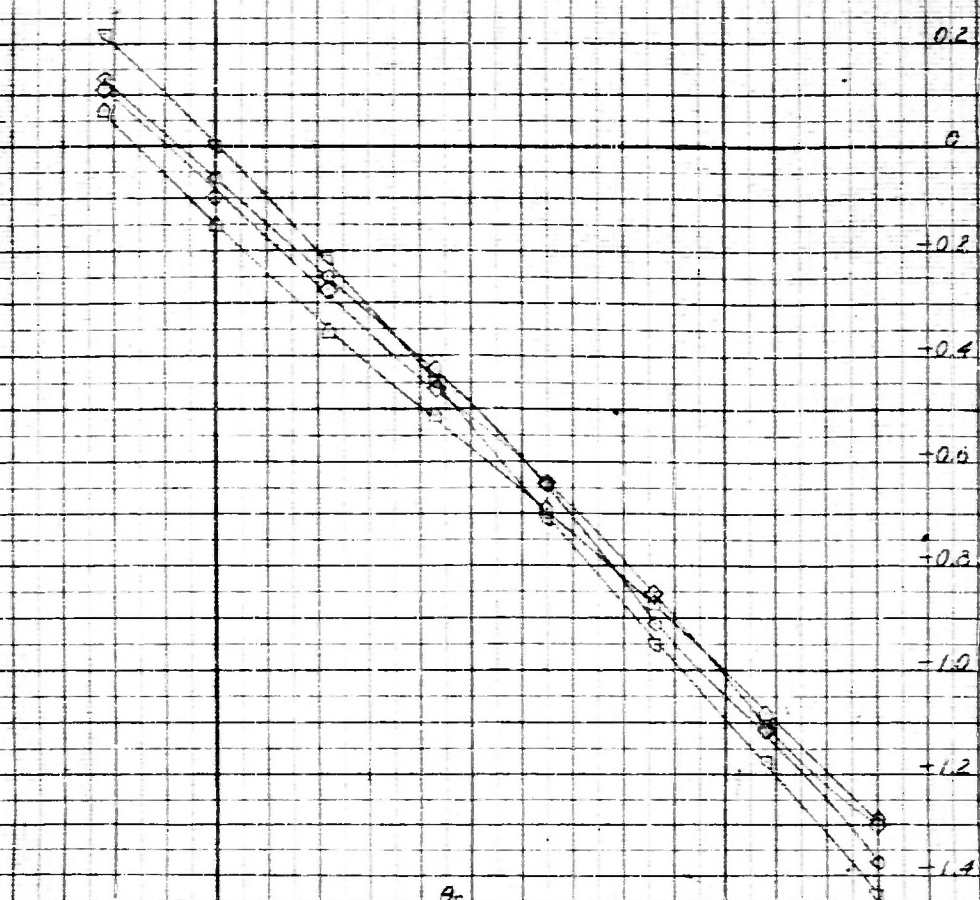
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NEO B. 4

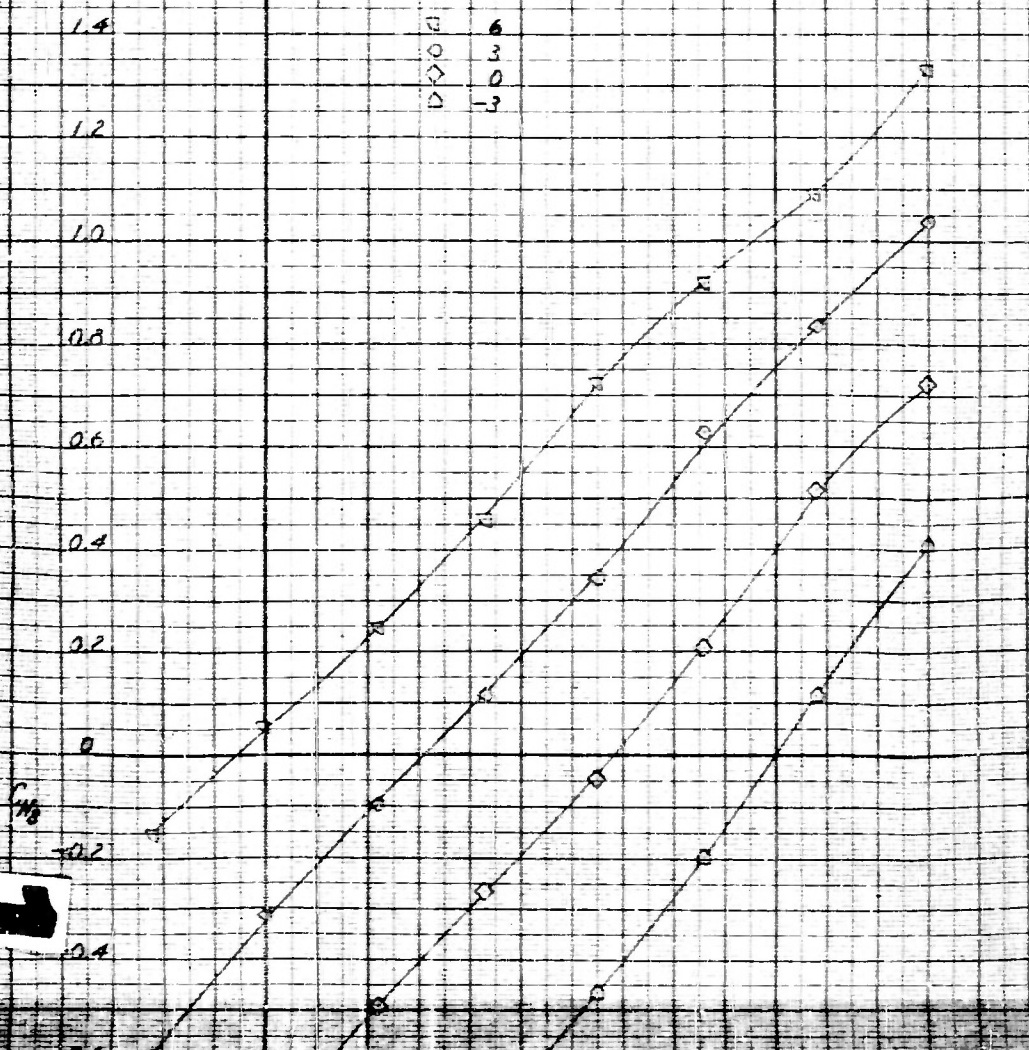
$\alpha$  in degrees



$\beta$   
in degrees

□	6
○	3
◇	0
△	-3

CONFIDENTIAL



1

2

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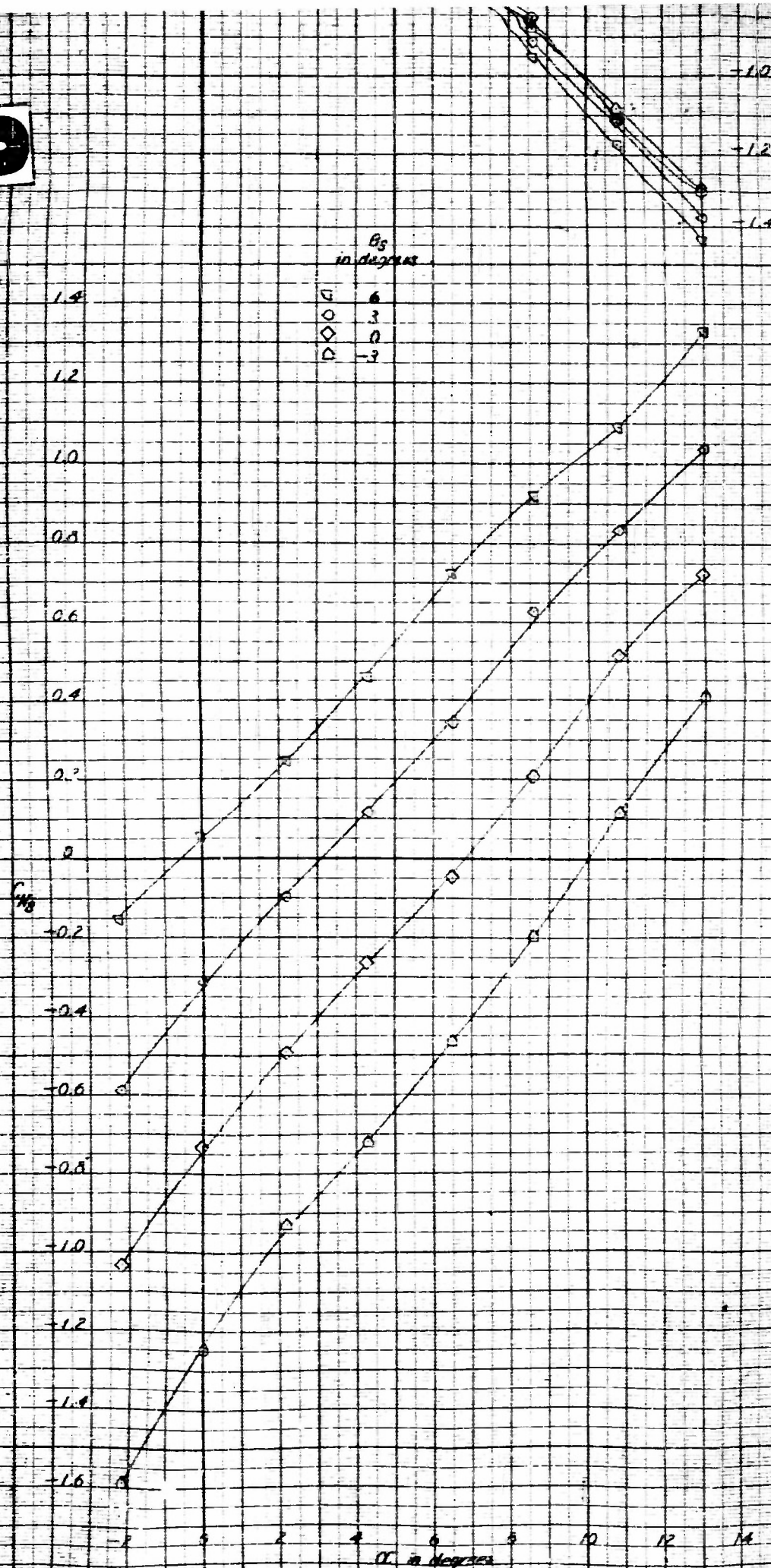


Figure 11 (Continued)

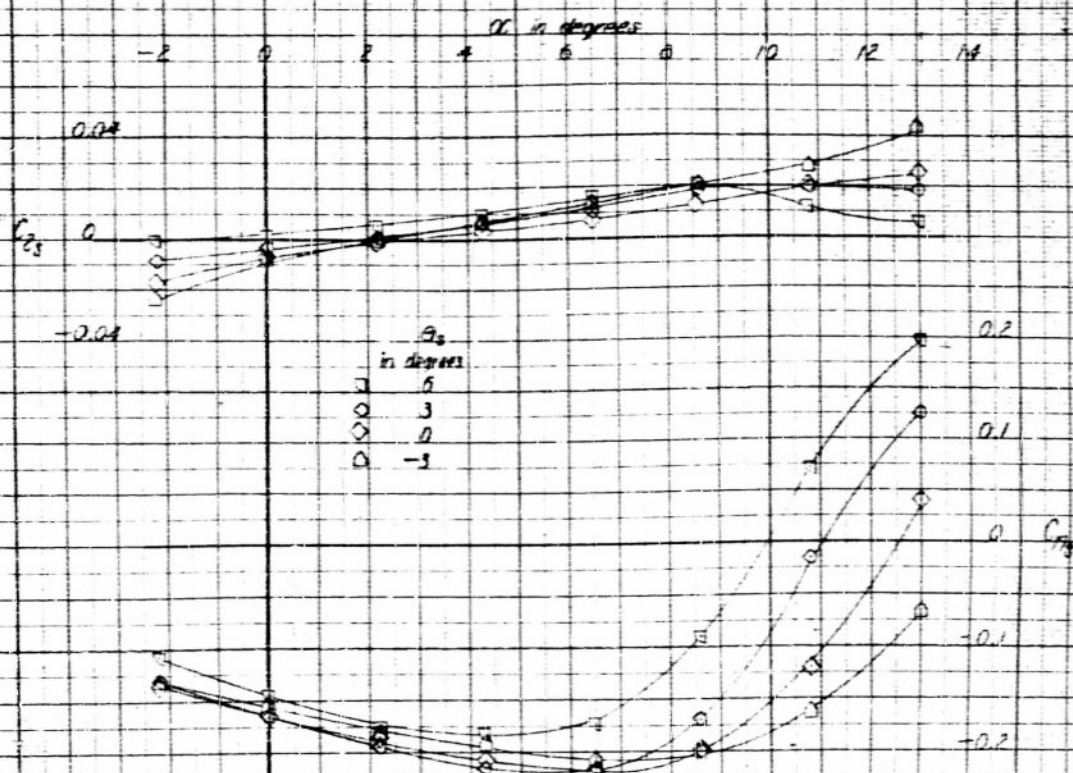
for  $z = 1.02$  Inches,  $x = 6.12$  Inches,  $\beta_0 = 0^\circ$ ,  $\beta' = 0^\circ$ , Pykard

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AERO 864



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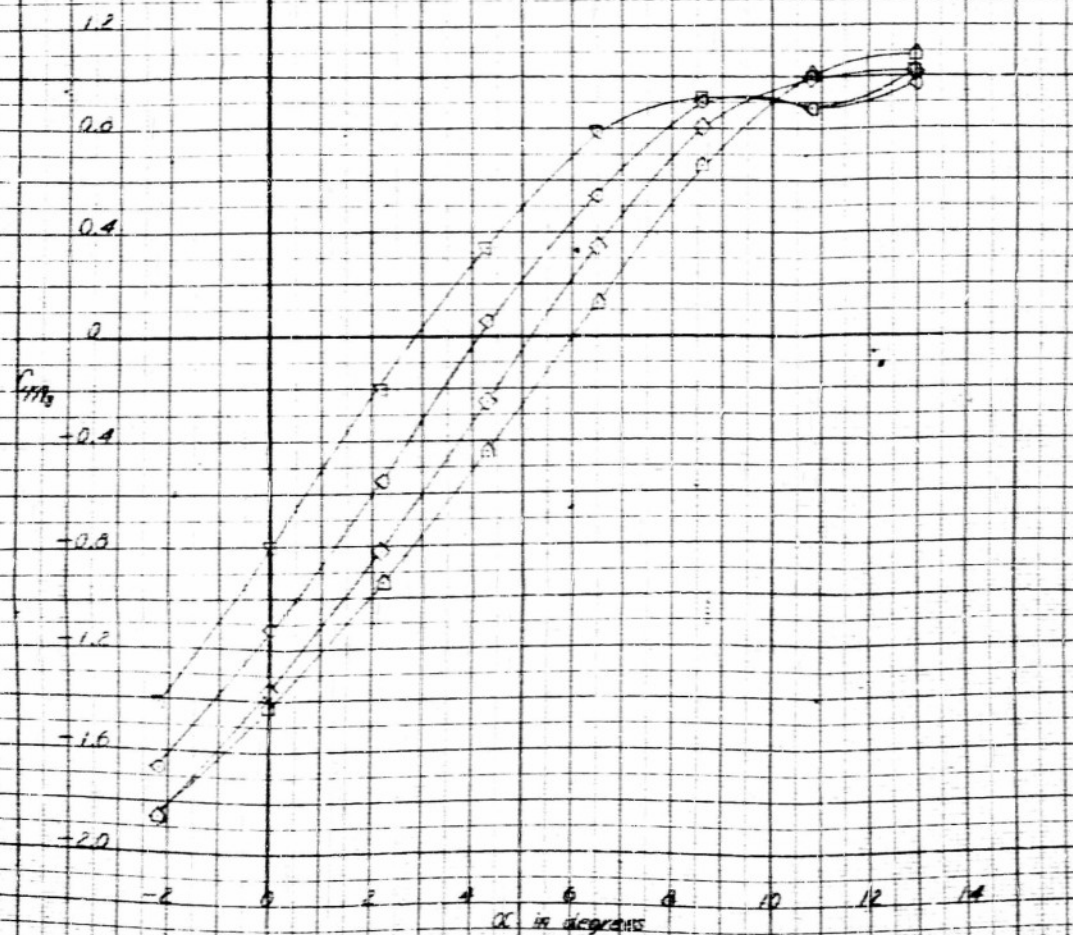


FIGURE 11e (Contd)

Figure 11a (Continued)

(b) Continued

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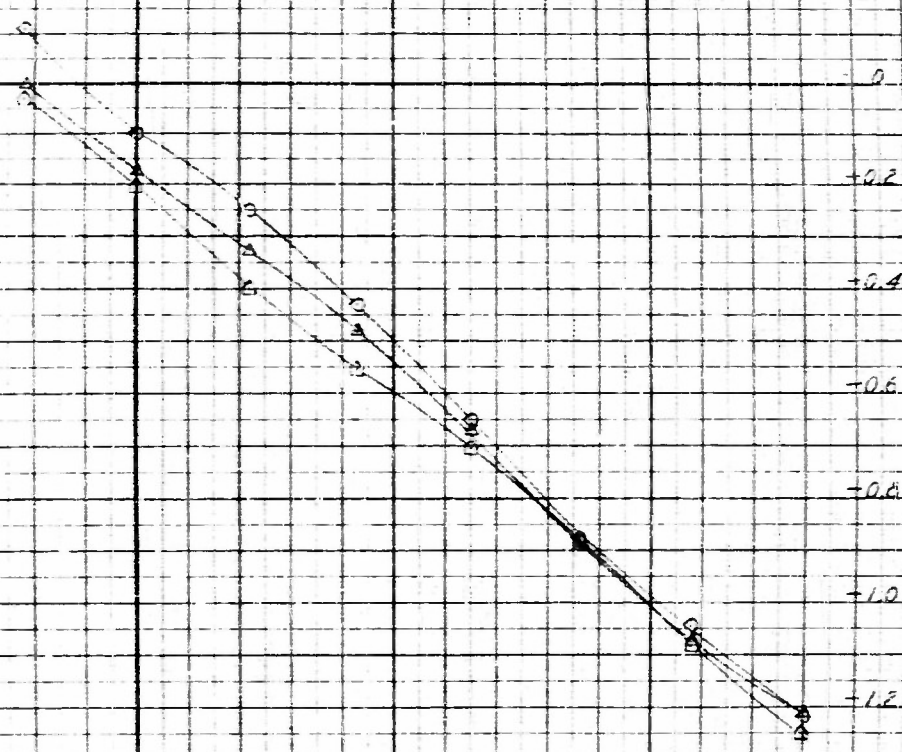


051000033

ALHO 867

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14  
0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2



$\theta_1$   
in degrees  
○ 1  
△ 6  
□ -3

1.2

1.0

0.8

0.6

0.4

0.2

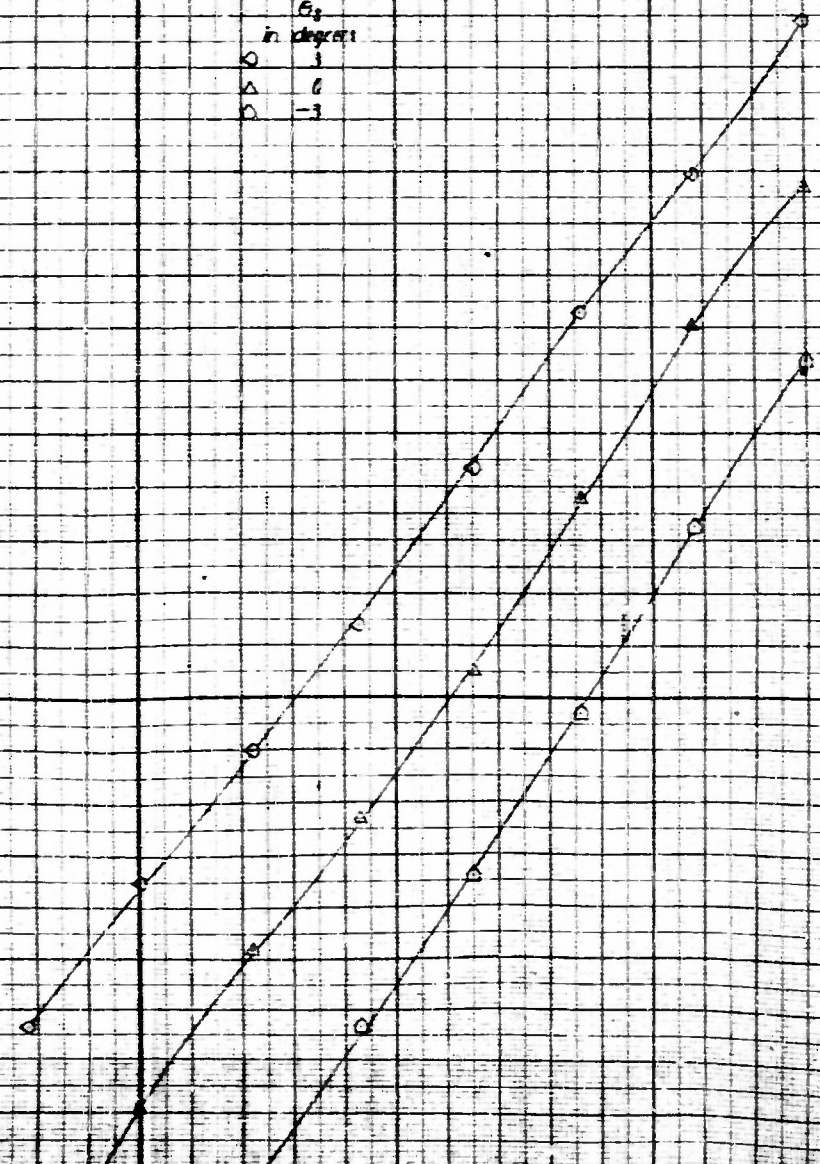
0

-0.2

-0.4

-0.6

-0.8



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2

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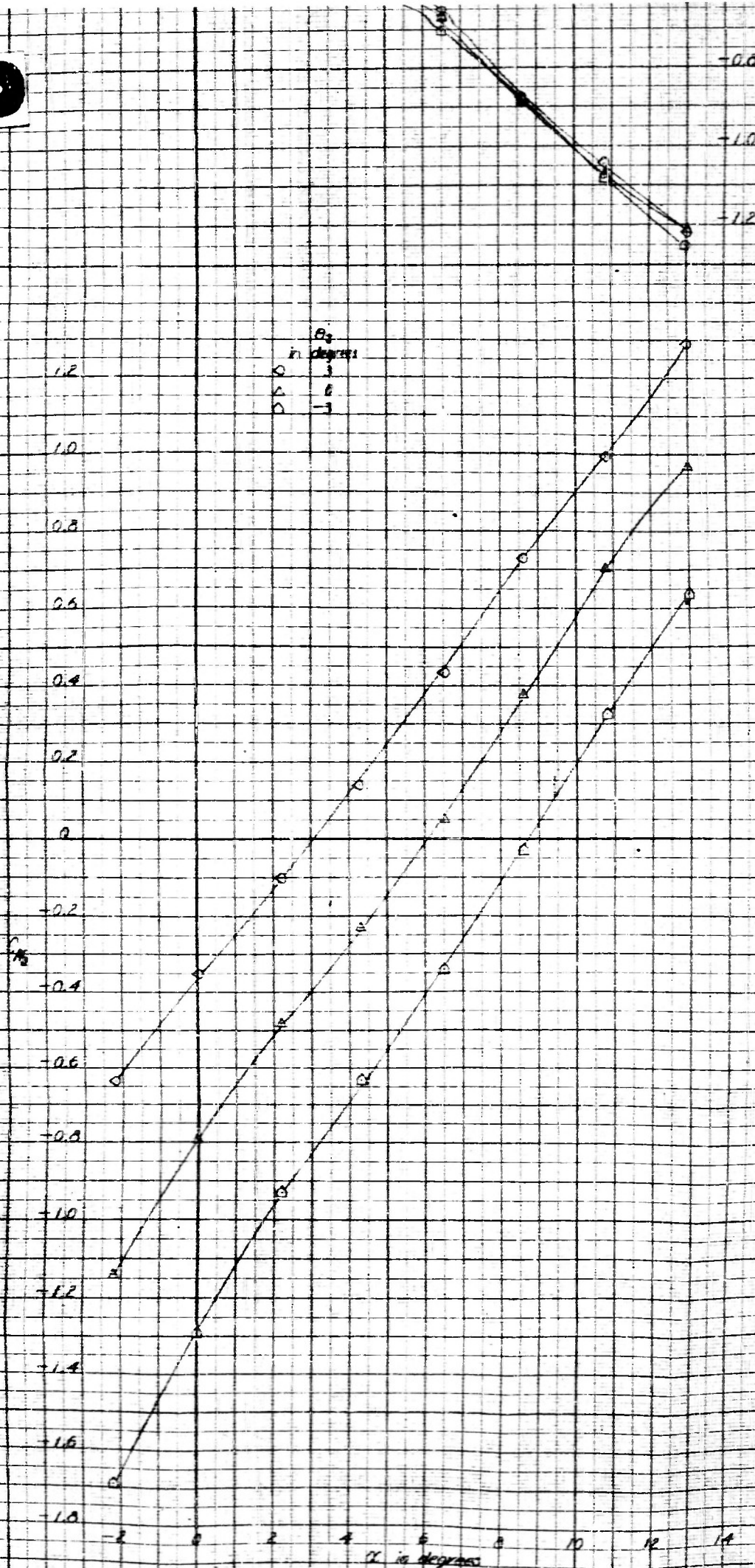


Figure 11 (Continued)

(f)  $z = 1.62$  Inches,  $x = 9.18$  Inches,  $\psi_1 = 0^\circ$ ,  $\psi_2 = 0^\circ$ , Pylon On

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ALRO 864

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FIGURE 17 (Contd)

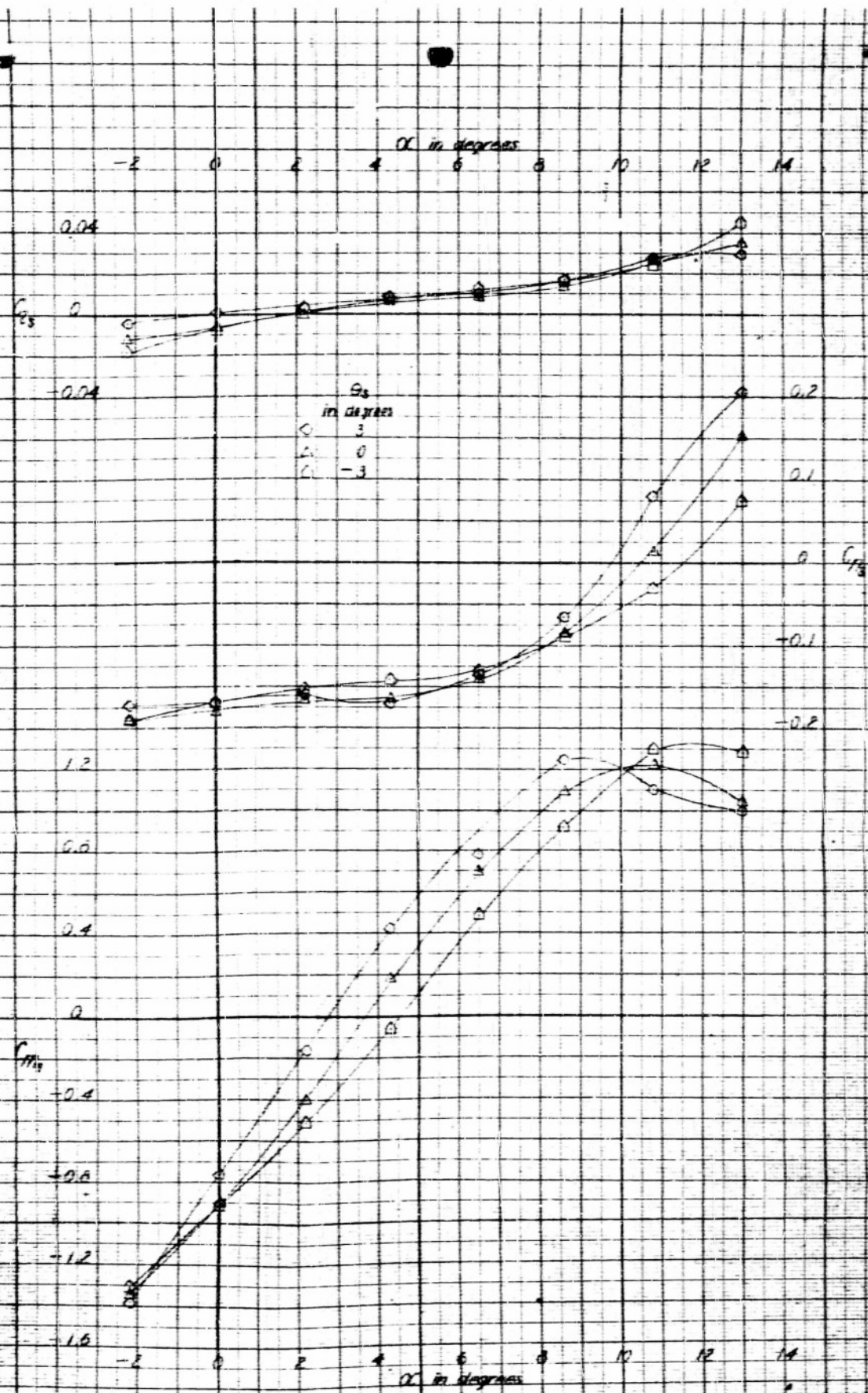
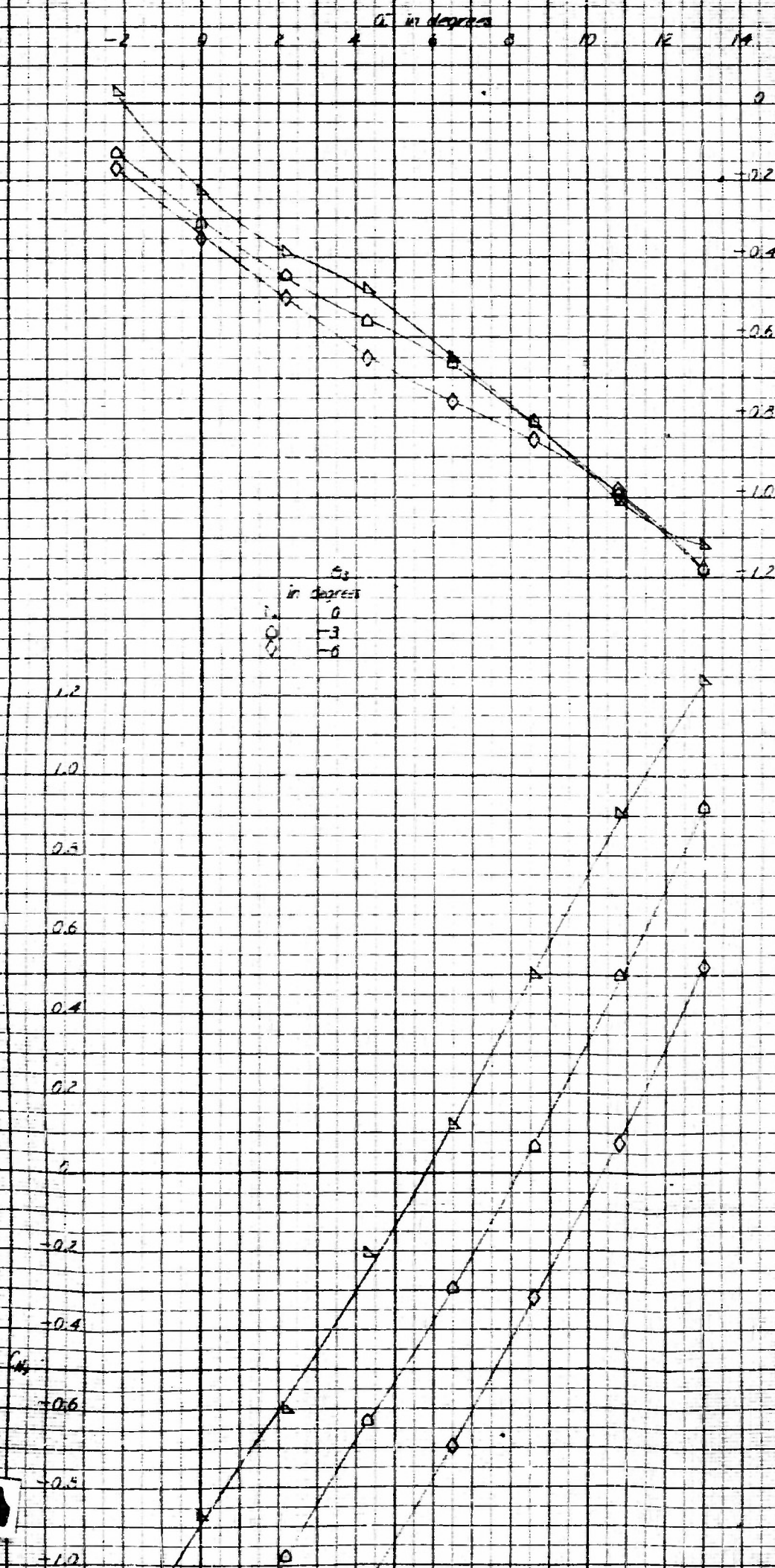


Figure 11 (Continued)

(f) Continued

AEHD 854

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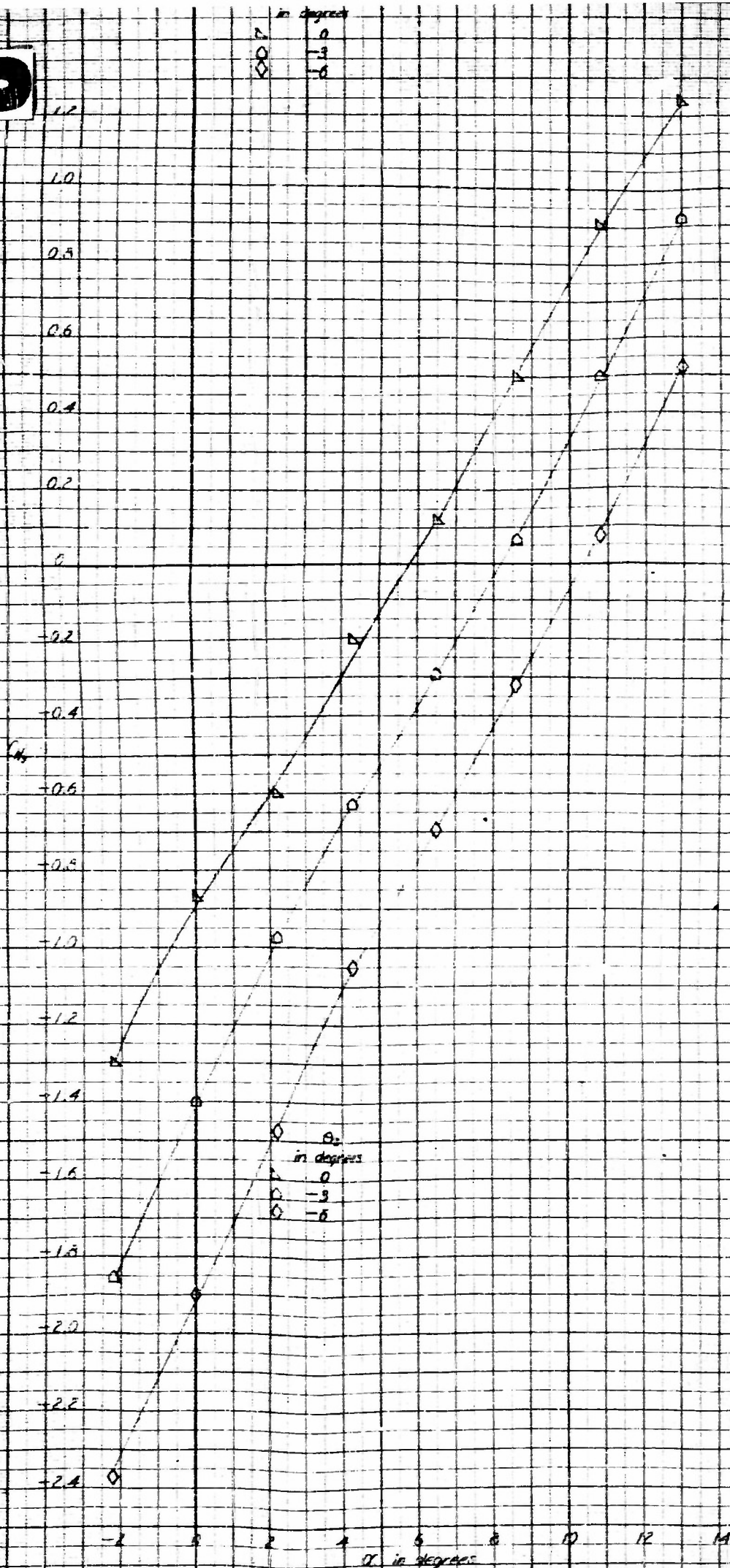


Figure 11 (Continued)

(a)  $z=1.02$  Inches,  $x=13.25$  Inches,  $\beta_1=0^\circ$ ,  $\beta_2=0^\circ$ , Pylon On

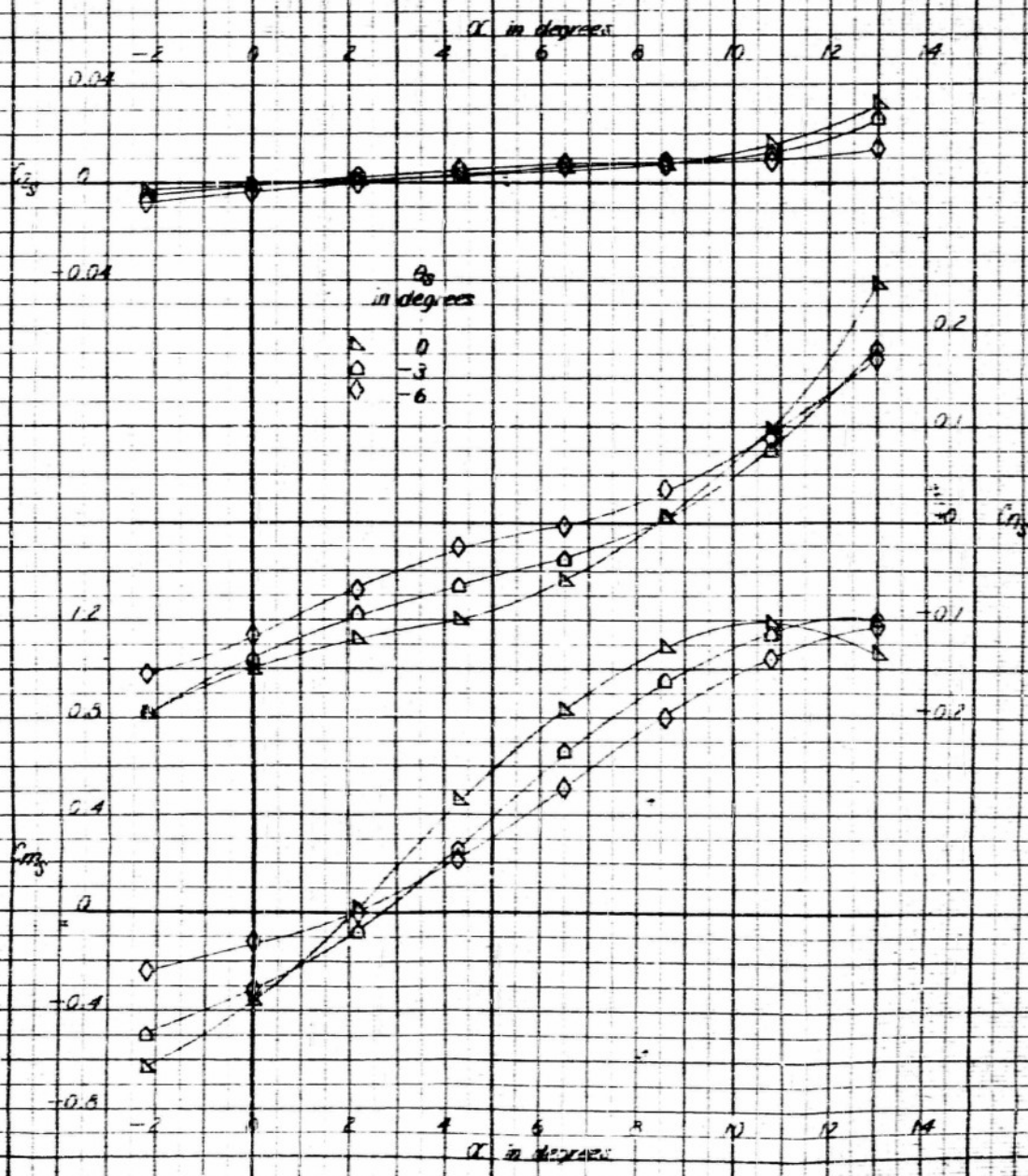
FIGURE 11/9

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AERO 864



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FIGURE 11g (cont.)

Figure 11 (Continued)  
b) Concluded

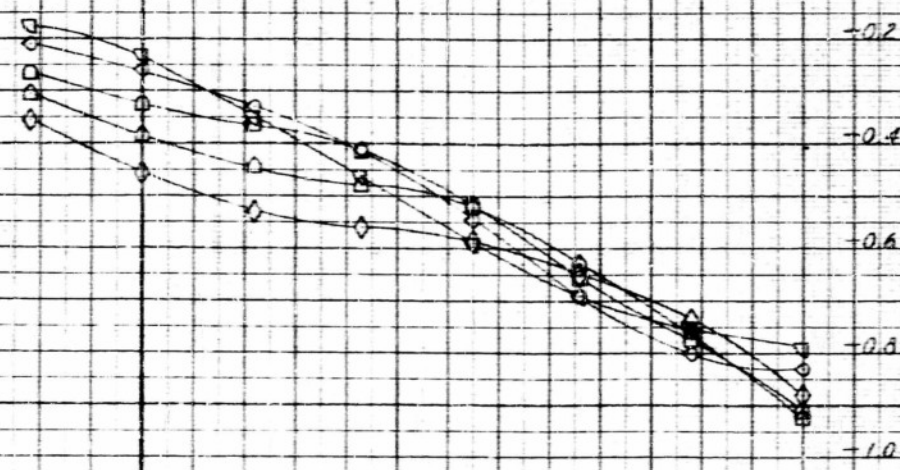
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12-20-45

AERO 85.4

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14



2.2

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

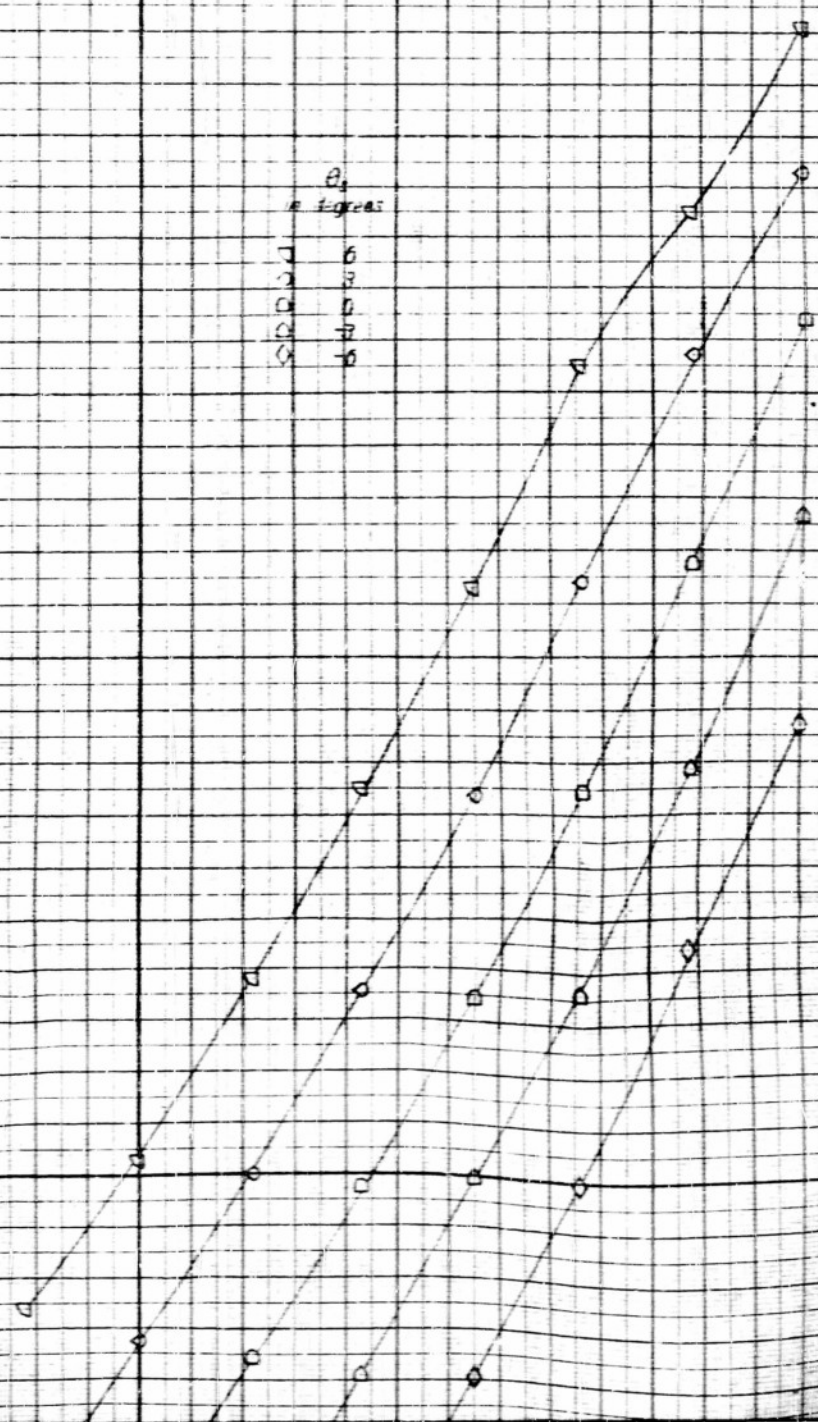
$C_N$

0.2

-0.4

$\beta$   
in degrees

6
5
4
3
2



CONFIDENTIAL



2

CONFIDENTIAL

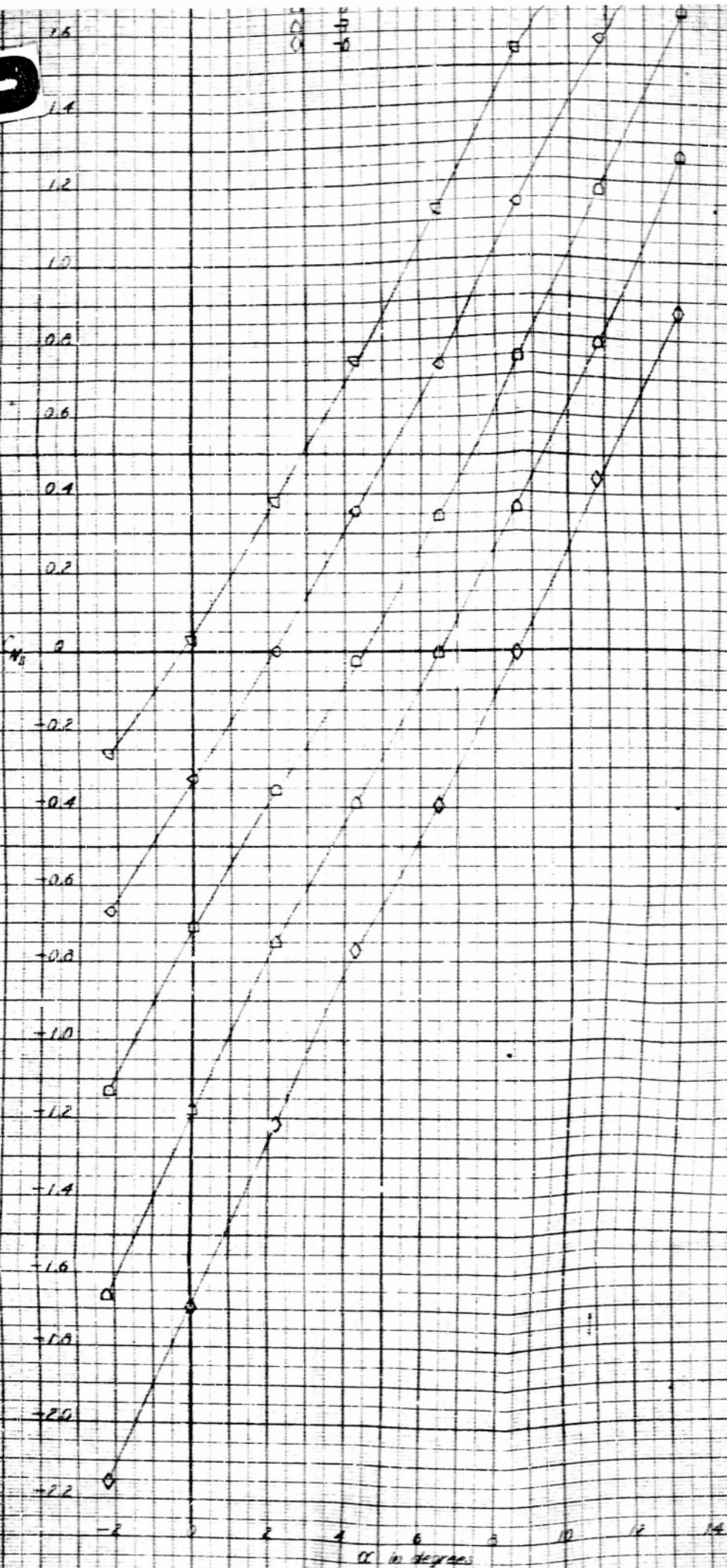


Figure 11 (Continued)

(1)  $Z = 1.0$  inches,  $r = 0.36$  inches,  $\omega = 0.35$  rad/sec

FIGURE 11

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AFRO 864

AFRO 864

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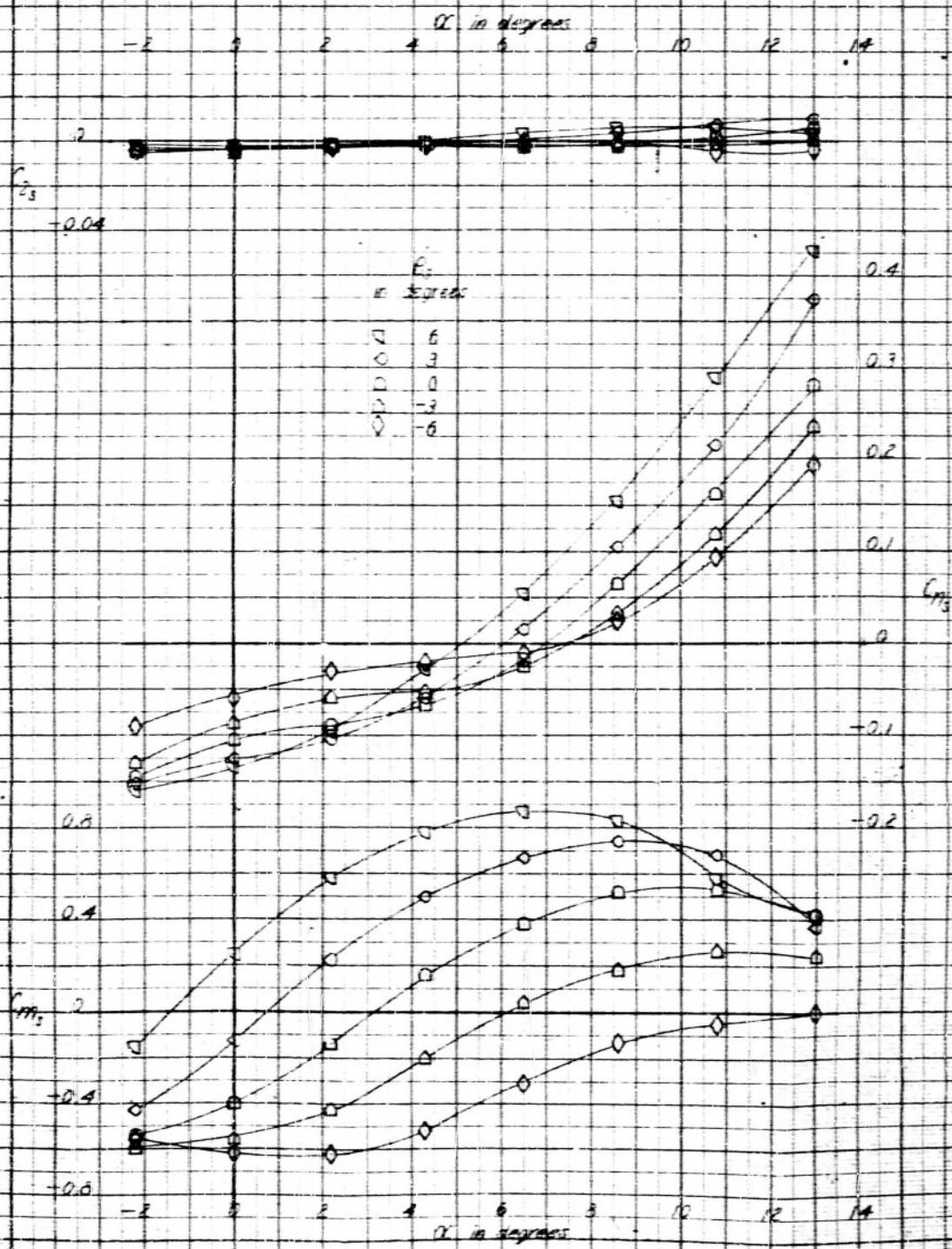


Figure 11 (Continued)  
By Conclusion

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AFRO 862

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0.2

0

-0.2

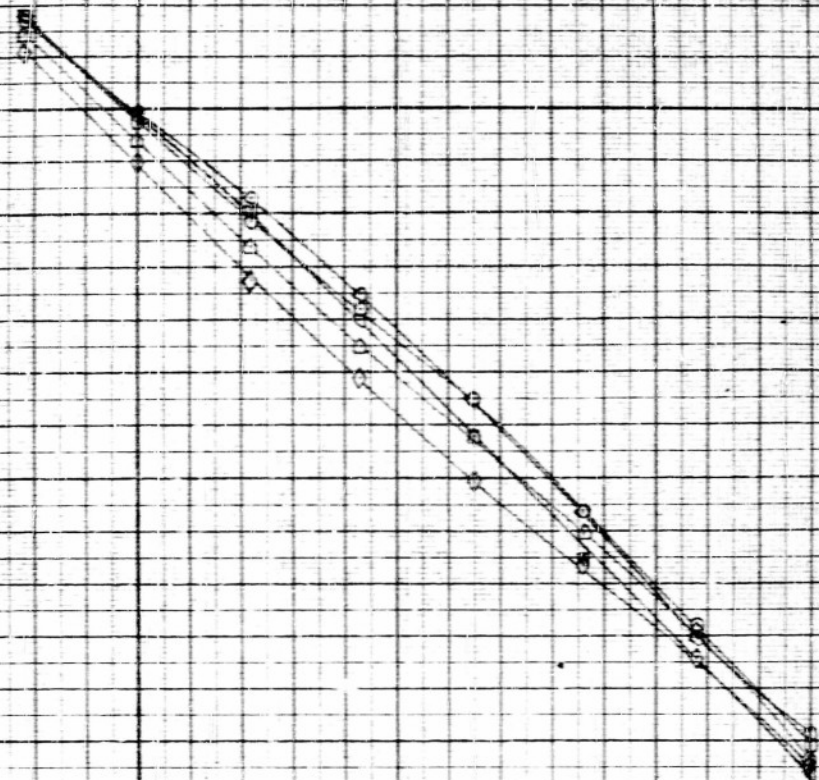
-0.4

-0.6

-0.8

-1.0

-1.2



1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

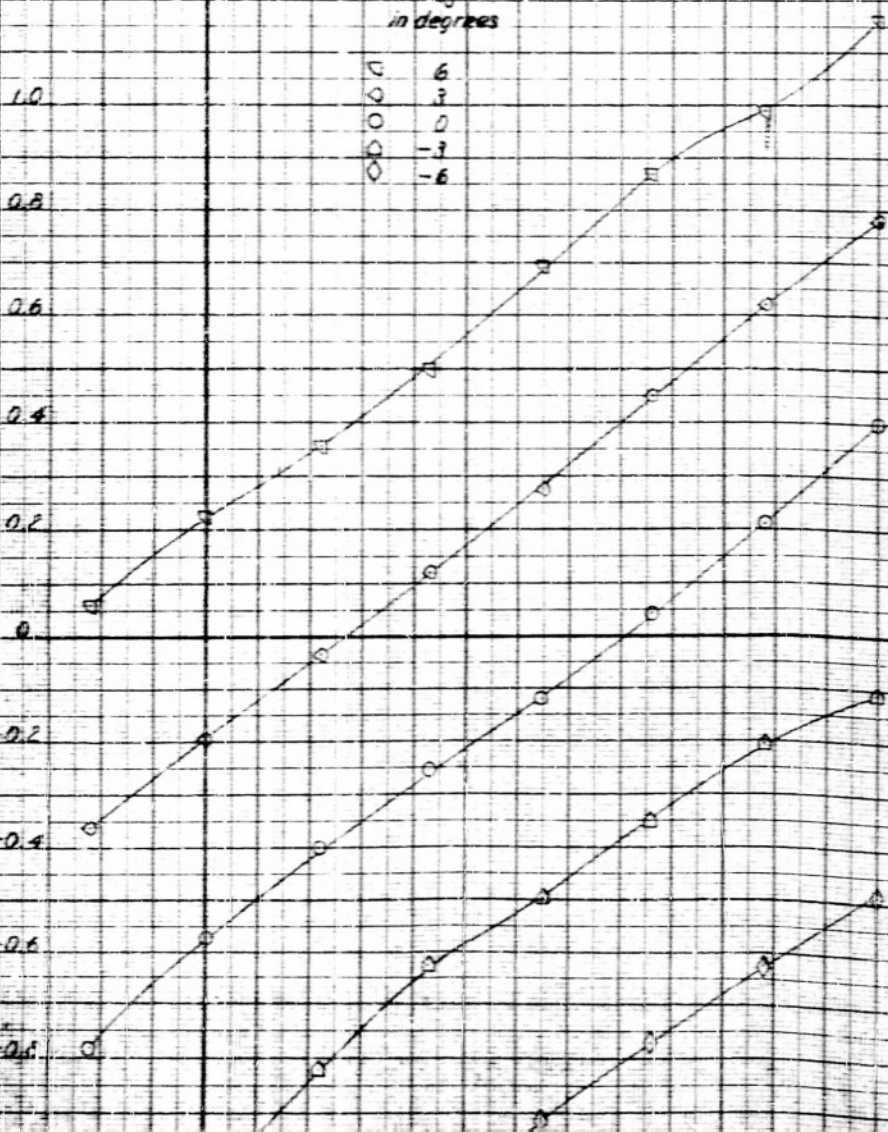
-0.4

-0.6

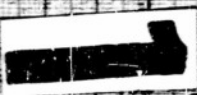
-0.8

$\theta_2$   
in degrees

- 6
- 3
- 0
- -3
- ◇ -6



CONFIDENTIAL



2

CONFIDENTIAL

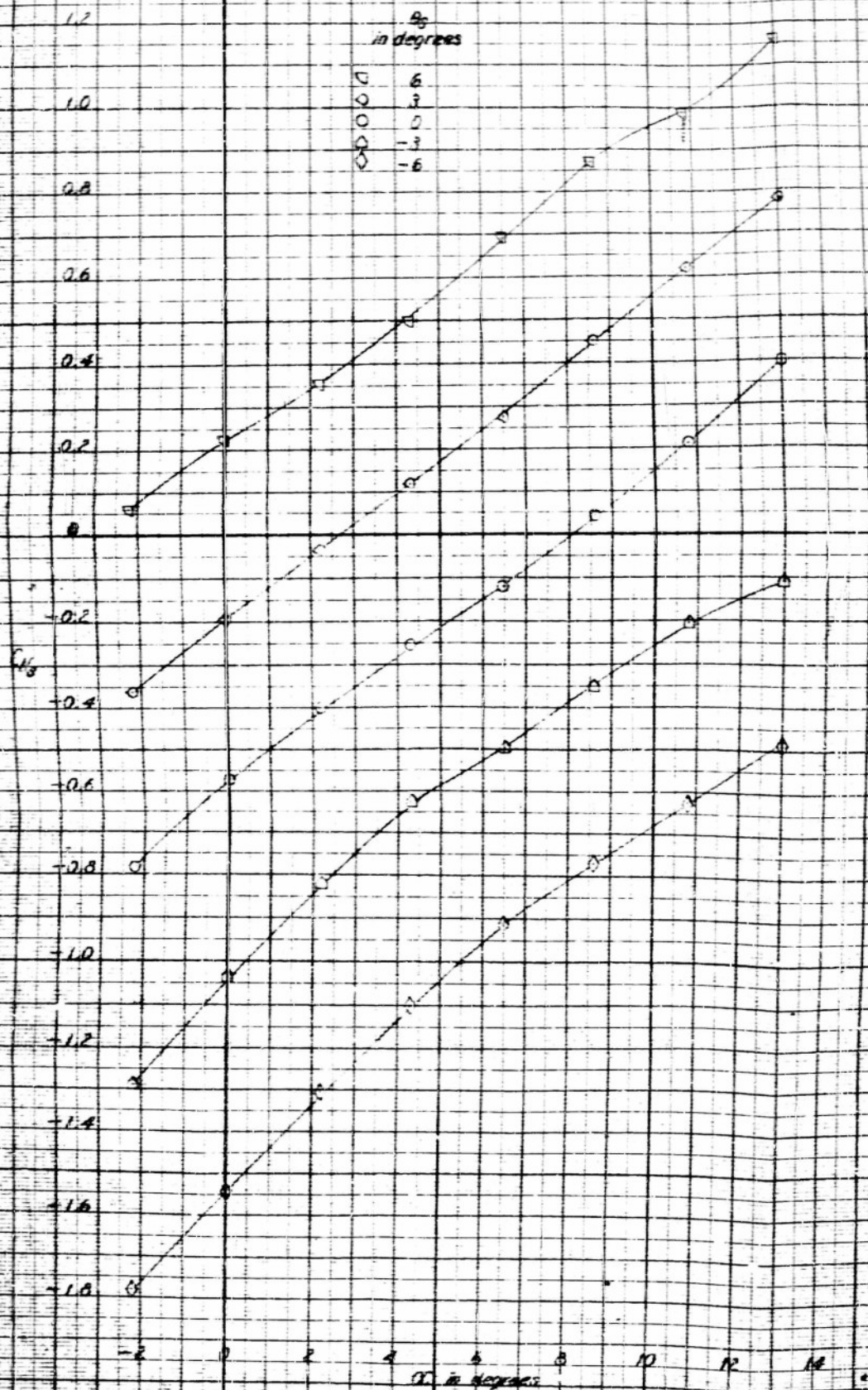


Figure 11 (Continued)

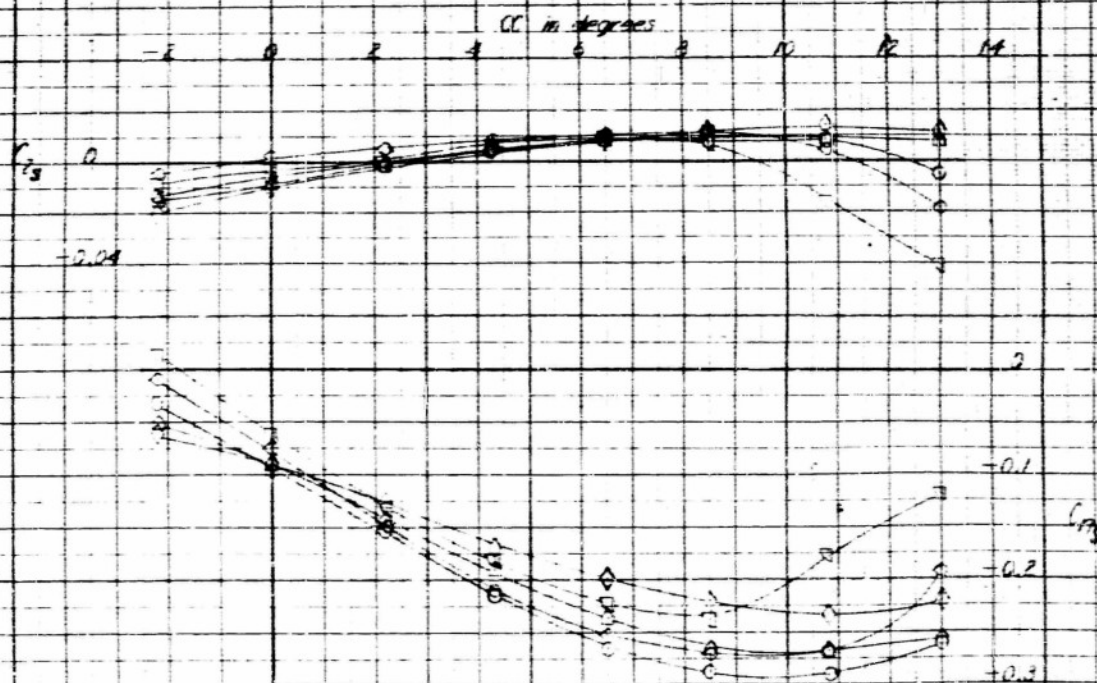
(ii)  $z = 2.042$  inches,  $x = 0.1$  inch,  $\phi_s = 0^\circ$ ,  $\phi = 0^\circ$ ,  $A_y/A_0 = 0.0$

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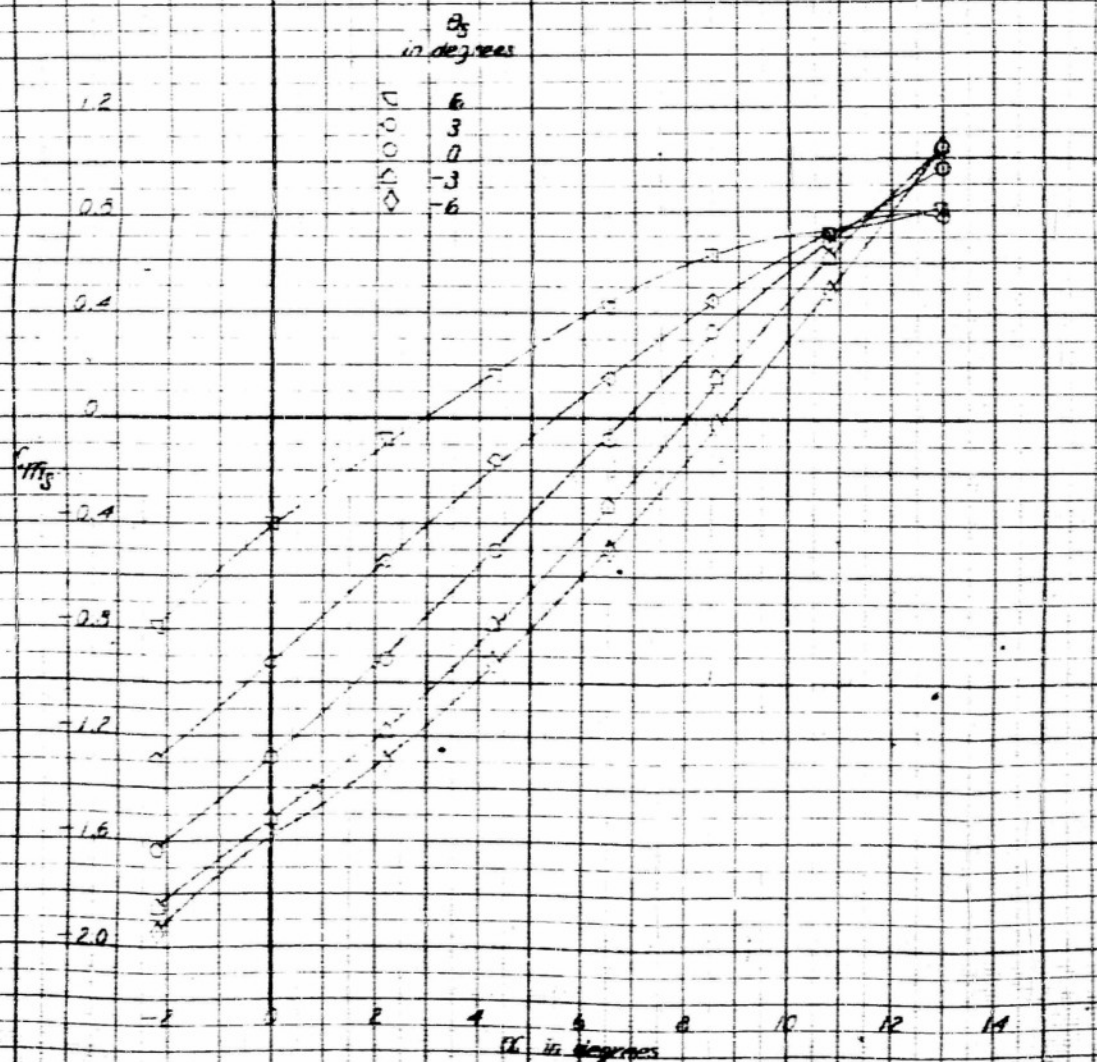


AFM 864

AS 504.33



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$\beta$   
in degrees  
6  
3  
0  
-3  
-6

FIGURE 11 (contd.)

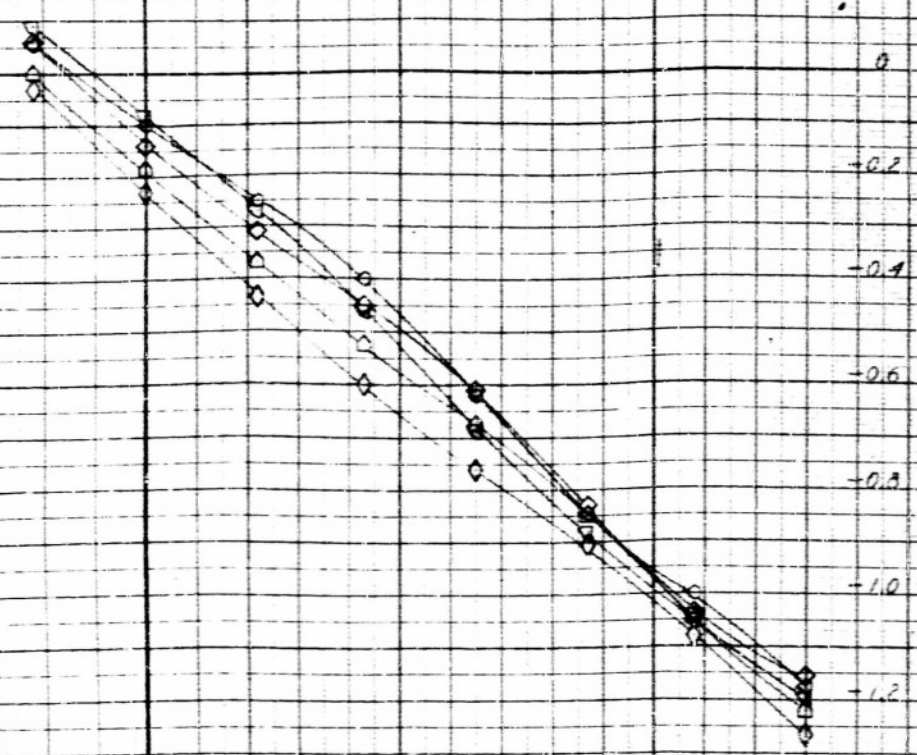
Figure 11 (Continued)  
(v) Concluded

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-60-

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AERO 654

$\alpha$  in degrees



$\beta$   
in degrees

6	◇
4	○
0	△
-3	◇
-6	◇

1.6  
1.4  
1.2  
1.0  
0.8  
0.6  
0.4  
0.2  
0  
-0.2  
-0.4  
-0.6

CONFIDENTIAL

1



2

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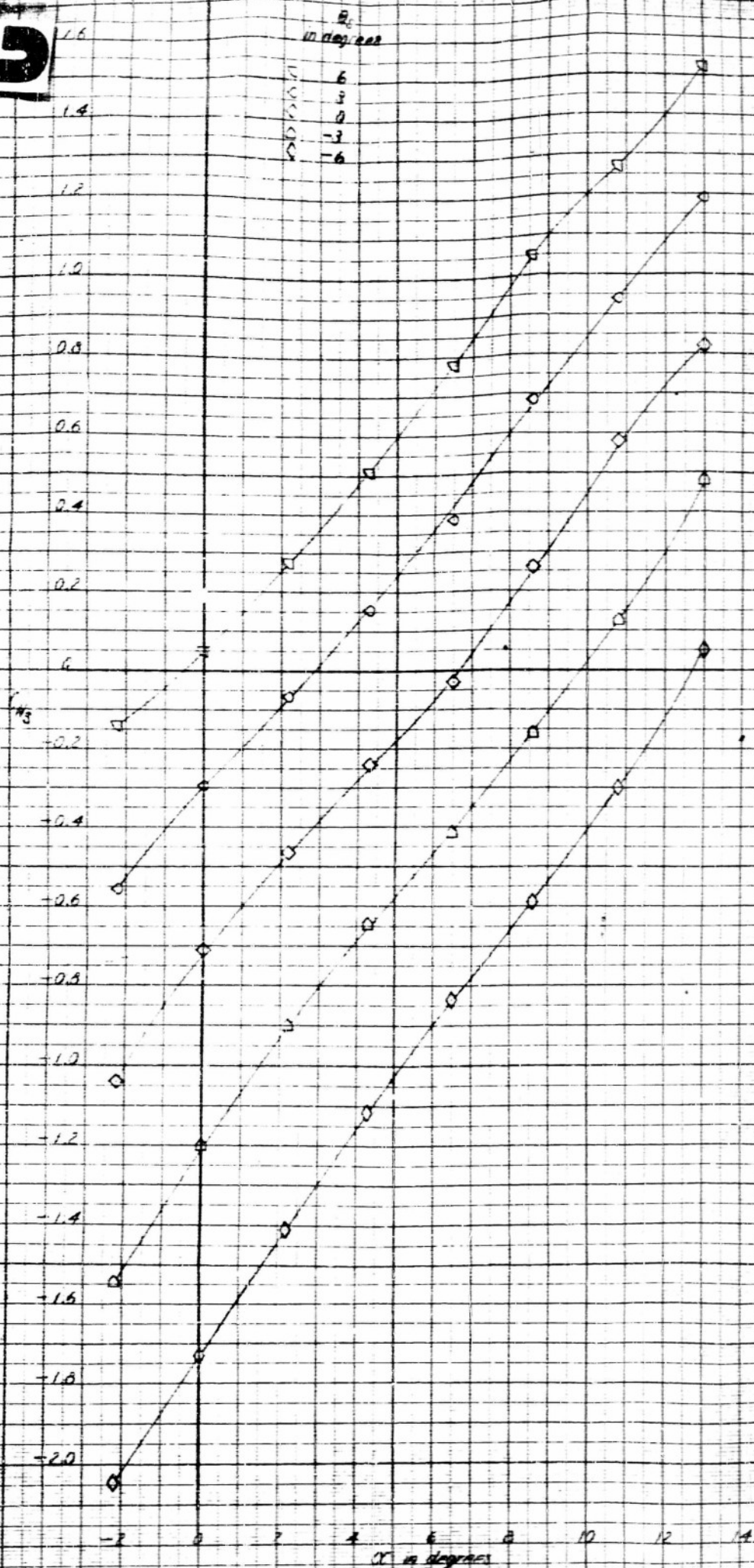
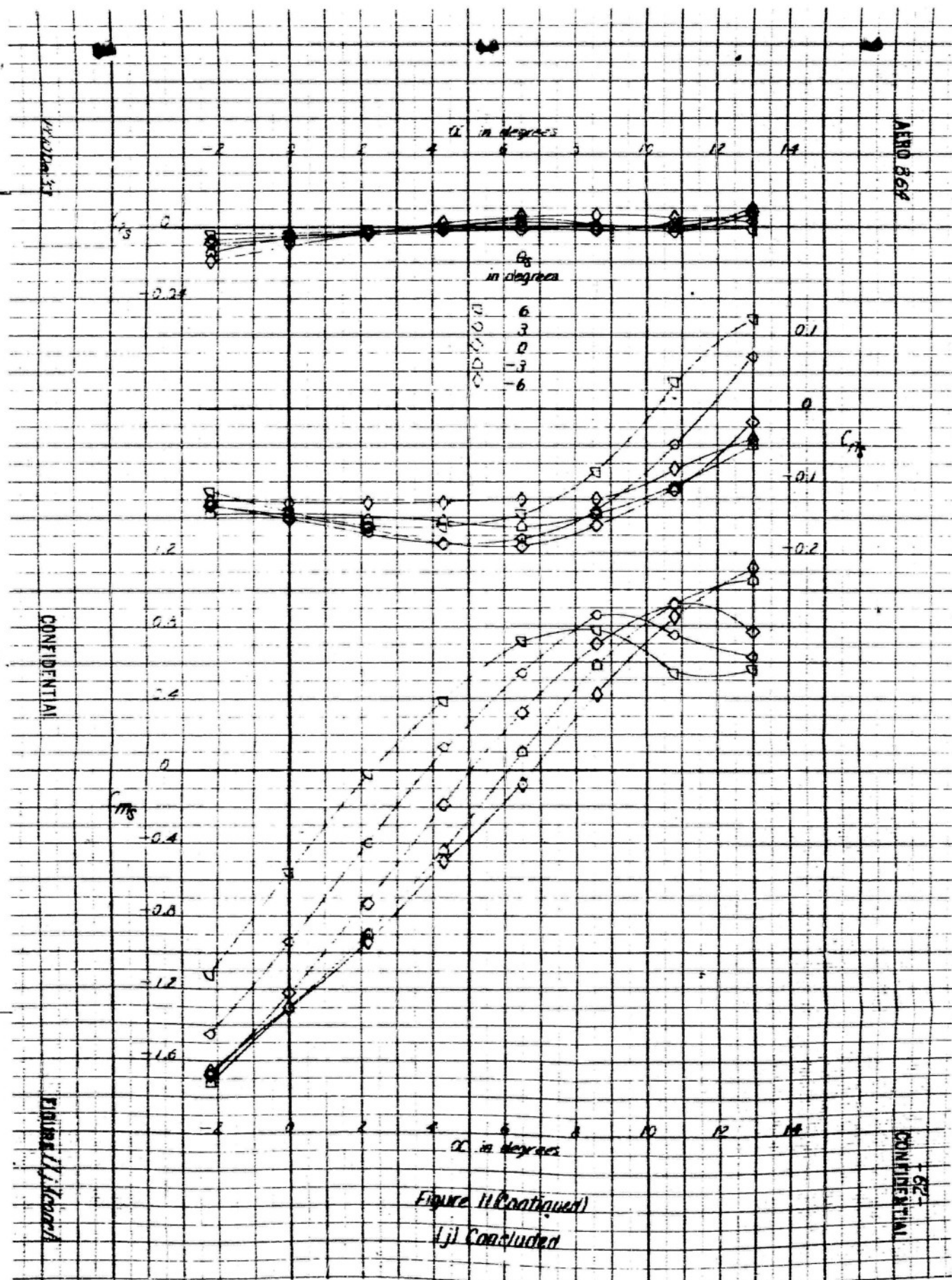


Figure 11 (Continued)

(j)  $\tau = 2.04$  Inches,  $x = 5.12$  Inches,  $\beta_0 = 0$ ,  $\beta = 0$ ,  $\beta_{\text{max}} = 0$

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$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0

-0.2

-0.4

-0.6

-0.8

-1.0

$C_{Y5}$

$\delta$  in degrees

6  
-3  
-6

1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

$C_{N5}$

-0.4

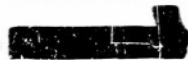
-0.6

-0.8

-1.0

-1.2

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2

$\alpha$  in degrees  
0  
-2  
-4  
-6

CONFIDENTIAL

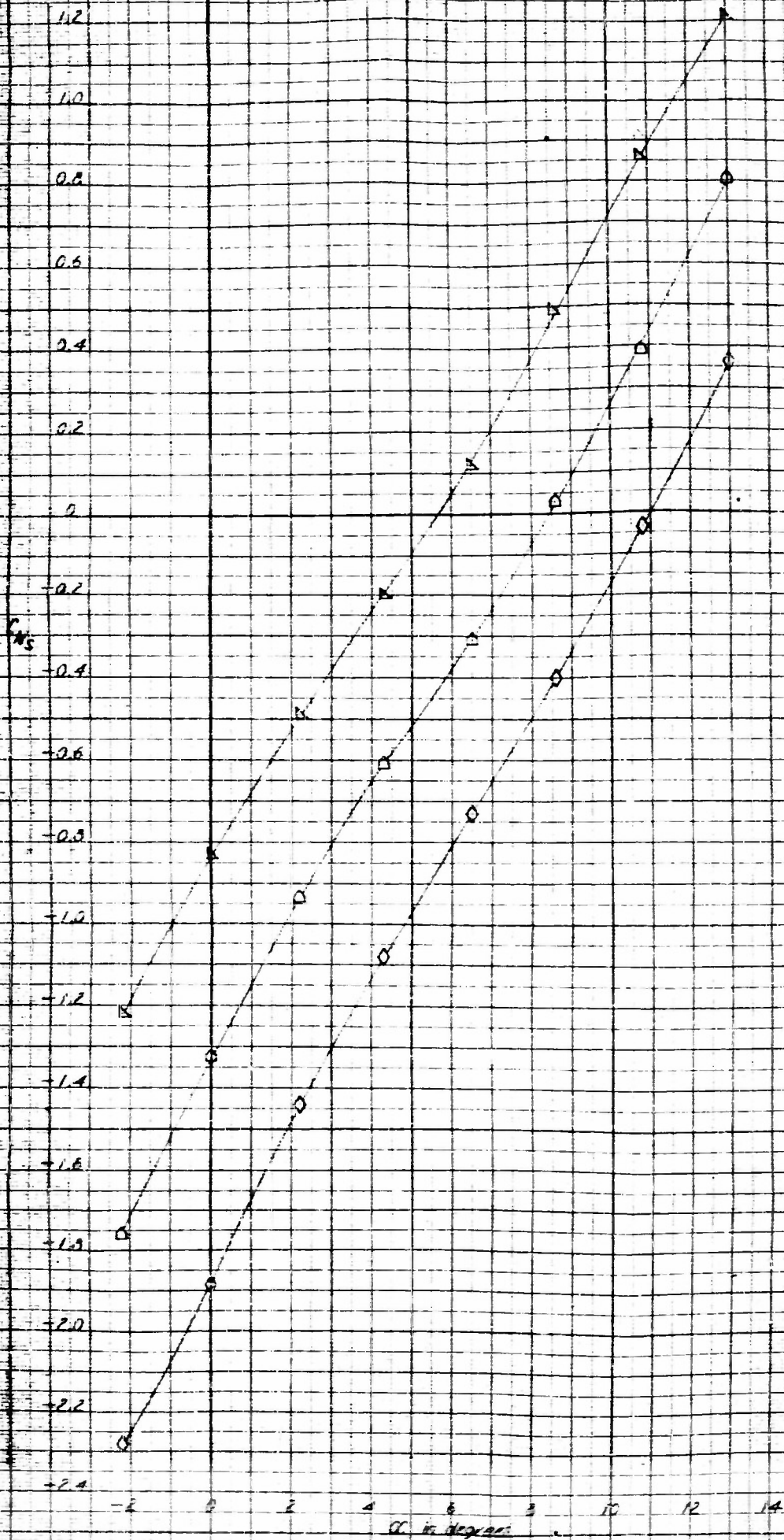
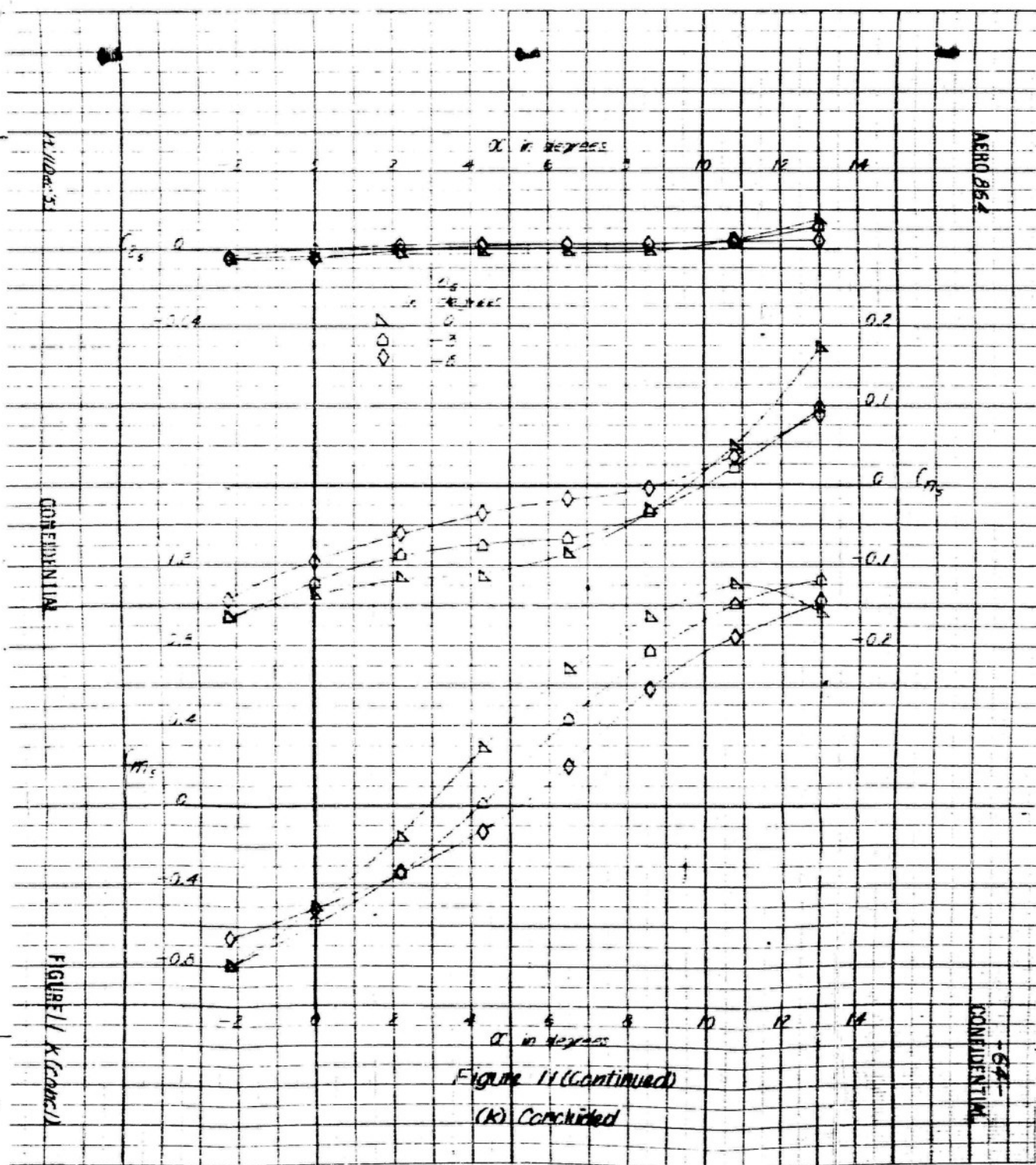


Figure 11 (Continued)

(\*)  $\alpha = 2$  at  $\text{Intercept} = 13.26 \text{ Inches}$ ,  $\alpha_0 = 0$ ,  $\alpha_1 = 0$ ,  $\alpha_2 = 0$

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12/1/62

$\alpha$  in degrees

AERO 862

-2 0 2 4 6 8 10 12 14

-0.2  
-0.4  
-0.6  
-0.8  
-1.0

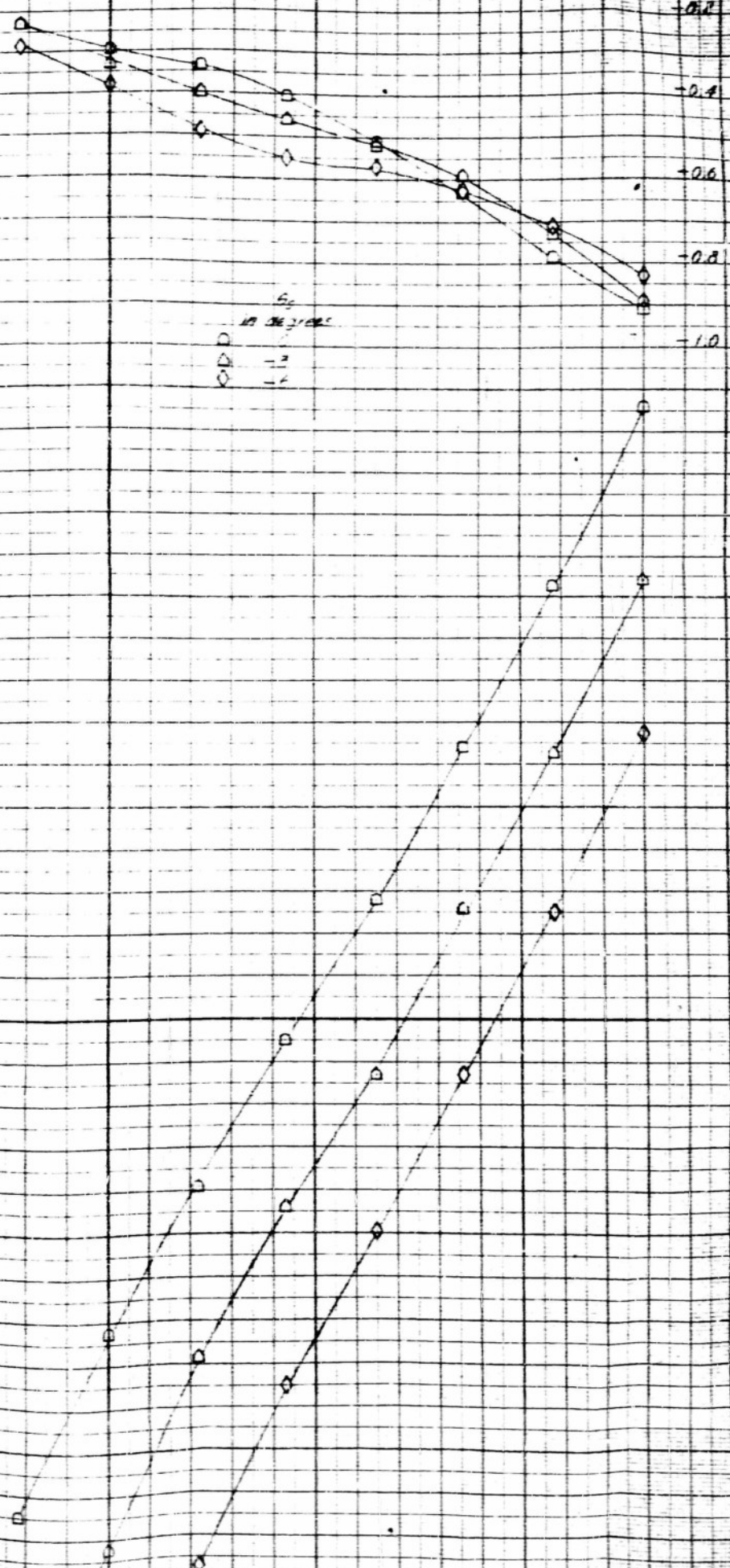
$C_{L\alpha}$   
in degrees  
□ -2  
◇ -4

1.4  
1.2  
1.0  
0.8  
0.6  
0.4  
0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2

CONFIDENTIAL

$C_{N\alpha}$

1



2

in degrees  
 ○ 2  
 △ 3  
 ◇ 4

-1.0

CONFIDENTIAL

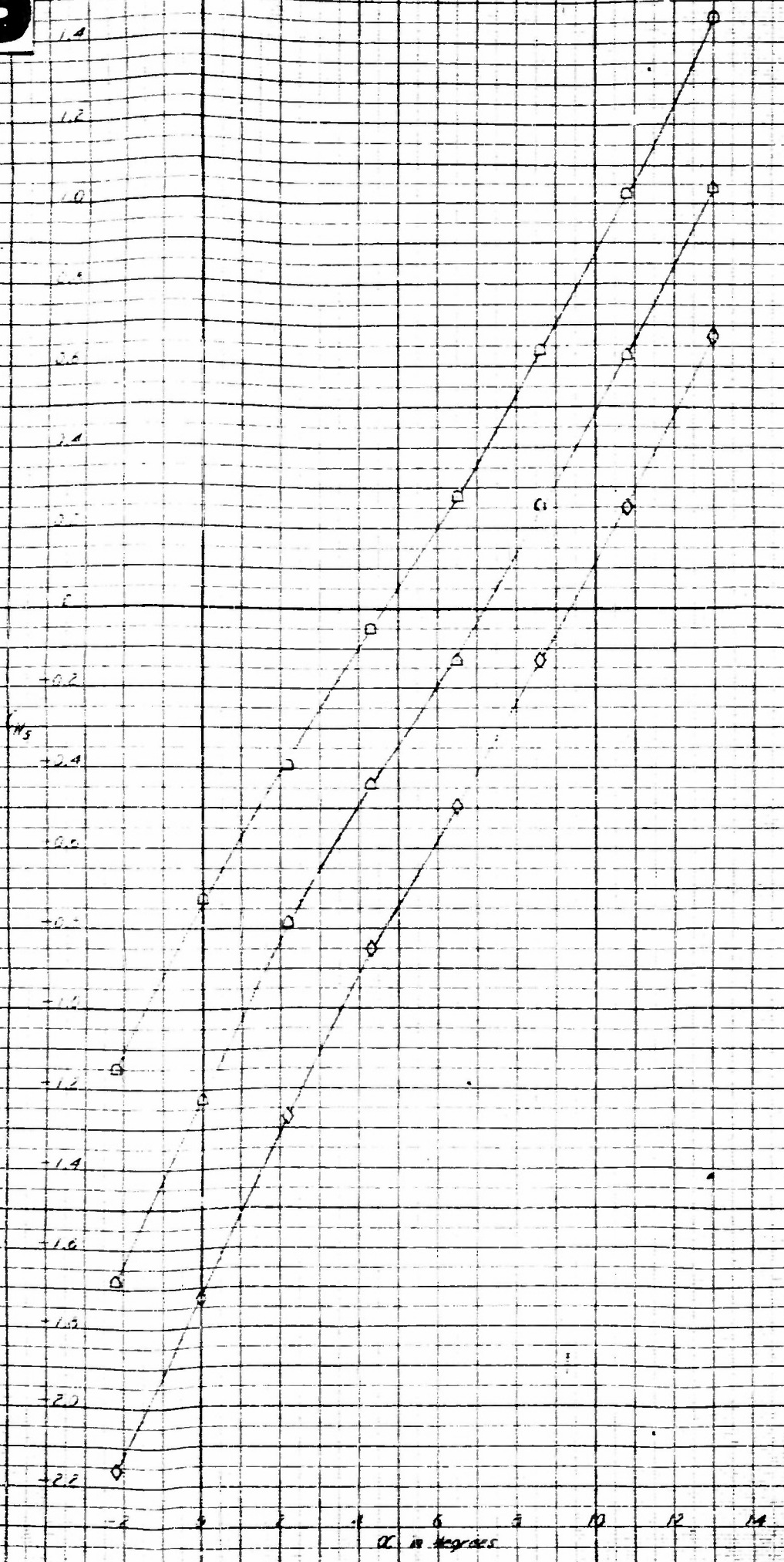


FIGURE 11C

Figure 11 (Continued)

Let  $z = 2.04$  Inches,  $x = 19.36$  Inches,  $k = 6$ ,  $W = 0$ . Eylon (in)

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AERO 864

0.0005

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FIGURE 11 (Contd.)

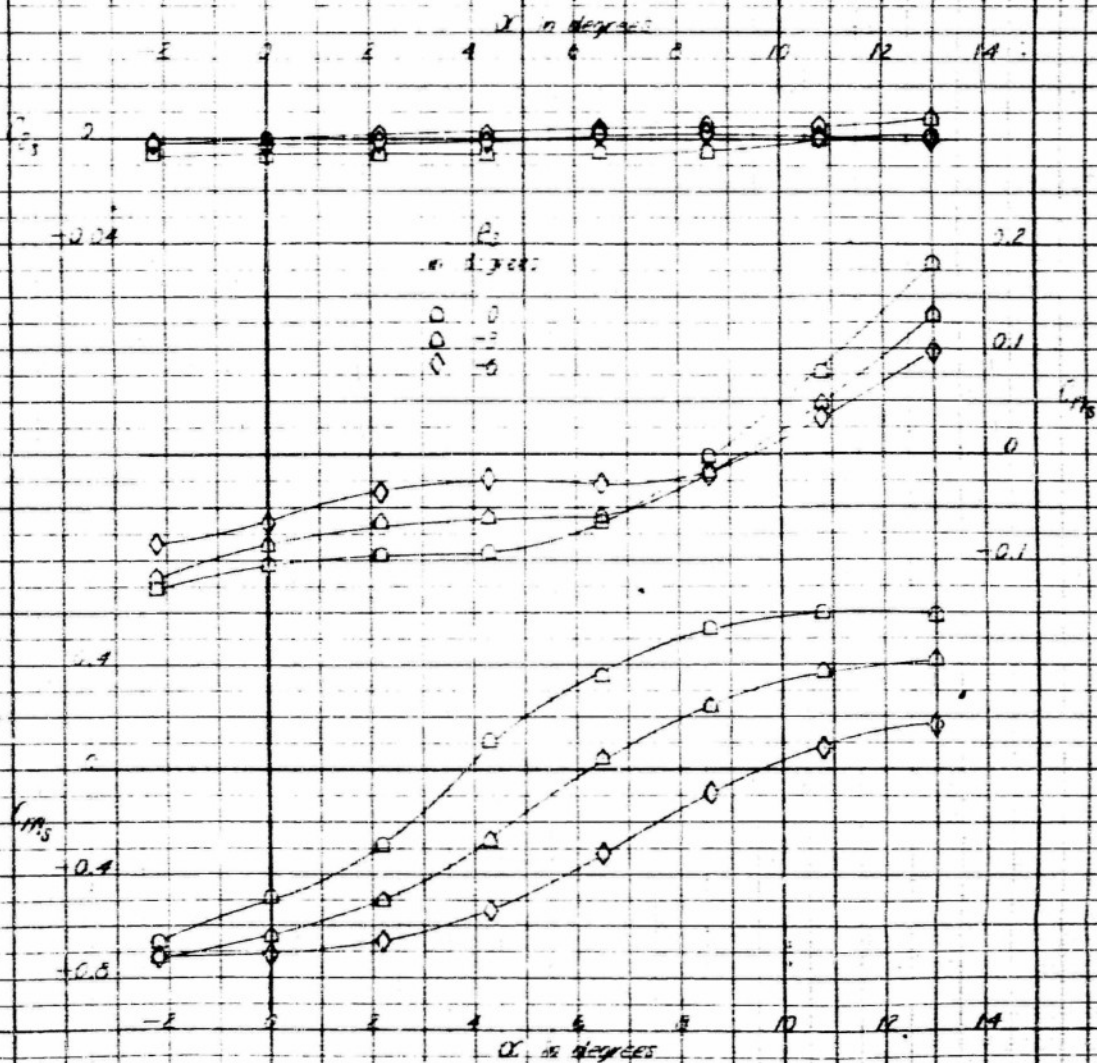


Figure 11 (Contd.)  
(a) Continued

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$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14 0.2

0

-0.2

-0.4  $C_{Y_2}$

-0.6

-0.8

-1.0

$\theta_2$   
in degrees:

- $\square$  6
- $\circ$  0
- $\diamond$  -6

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1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

-0.4

-0.6

-0.8

-1.0

-1.2

1

2

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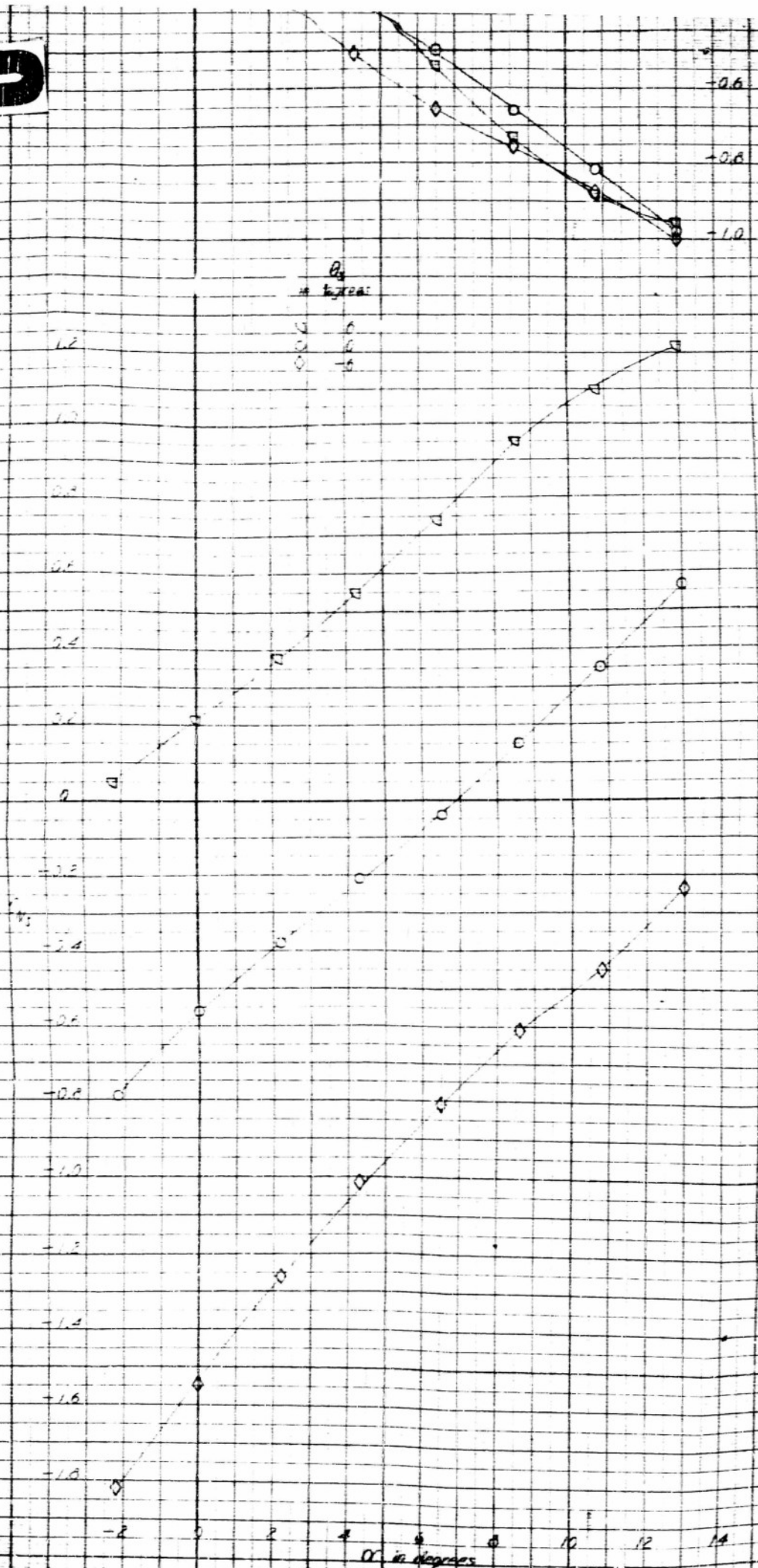


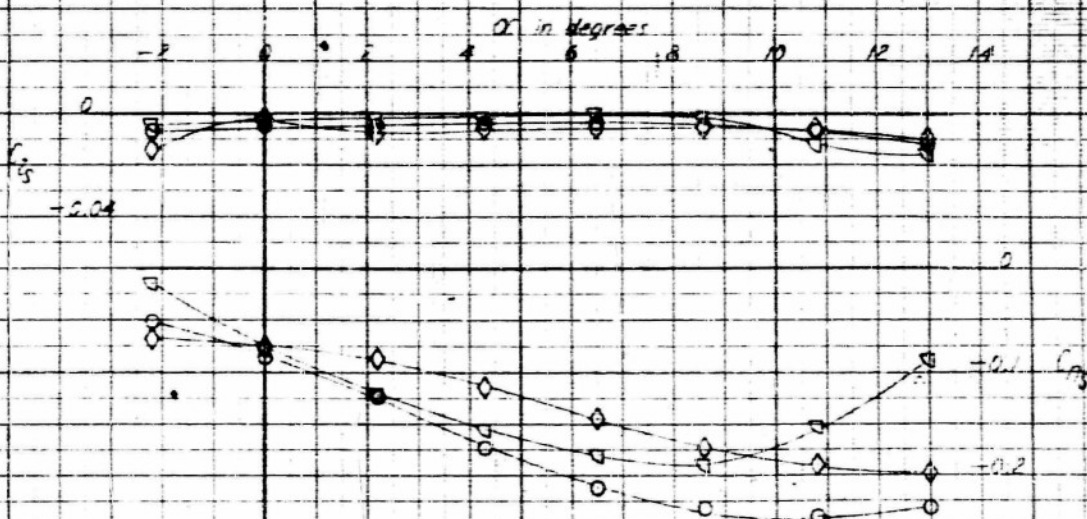
FIGURE 11 (Continued)

(a)  $Z = 4.98$  inches,  $r = 0.1$  inch,  $\theta_0 = 0^\circ$ ,  $\theta = 0^\circ$ , Pyrex 70

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AERO 863



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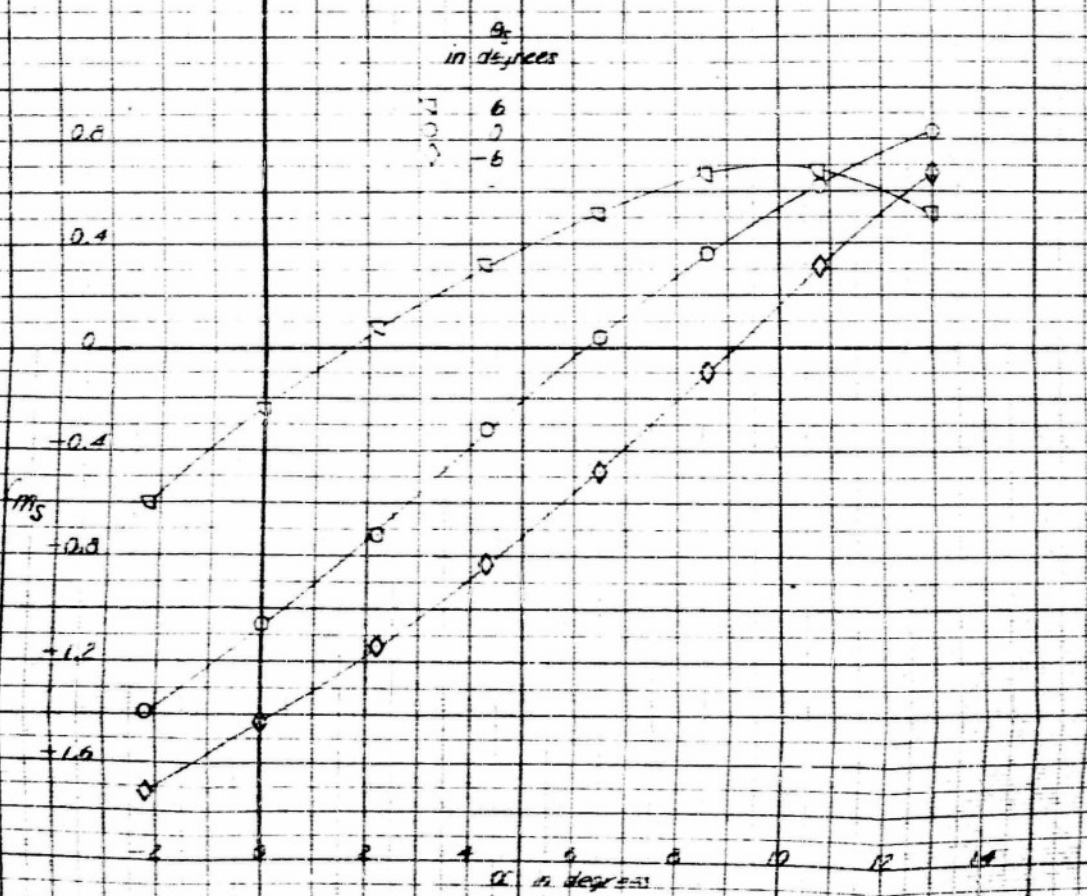


FIGURE 11 (cont)

Figure 11 (Concluded)  
1st Concluded

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AFRO 864

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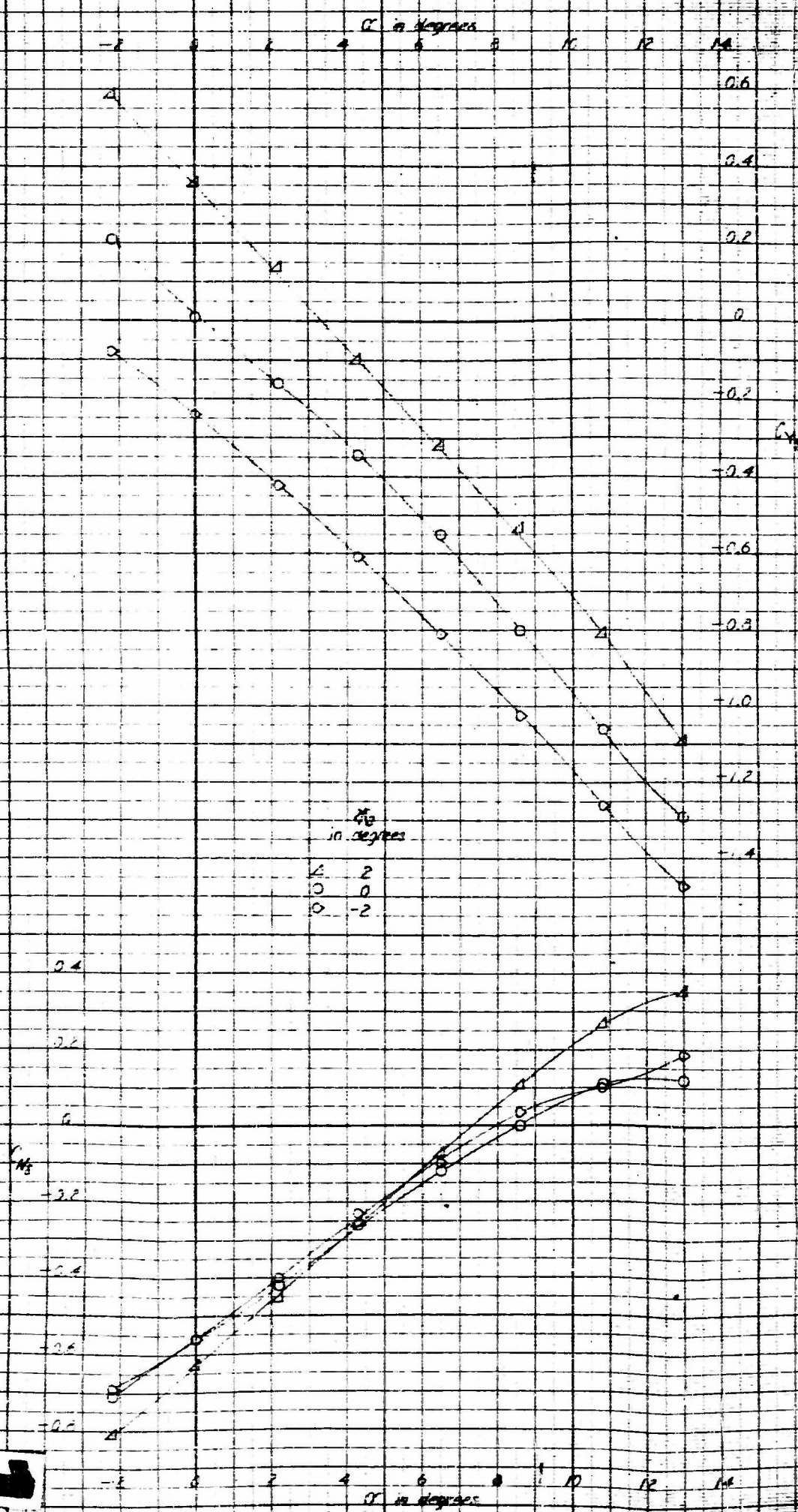


FIGURE 12 - Aerodynamic Characteristics of 1/17 Scale Model



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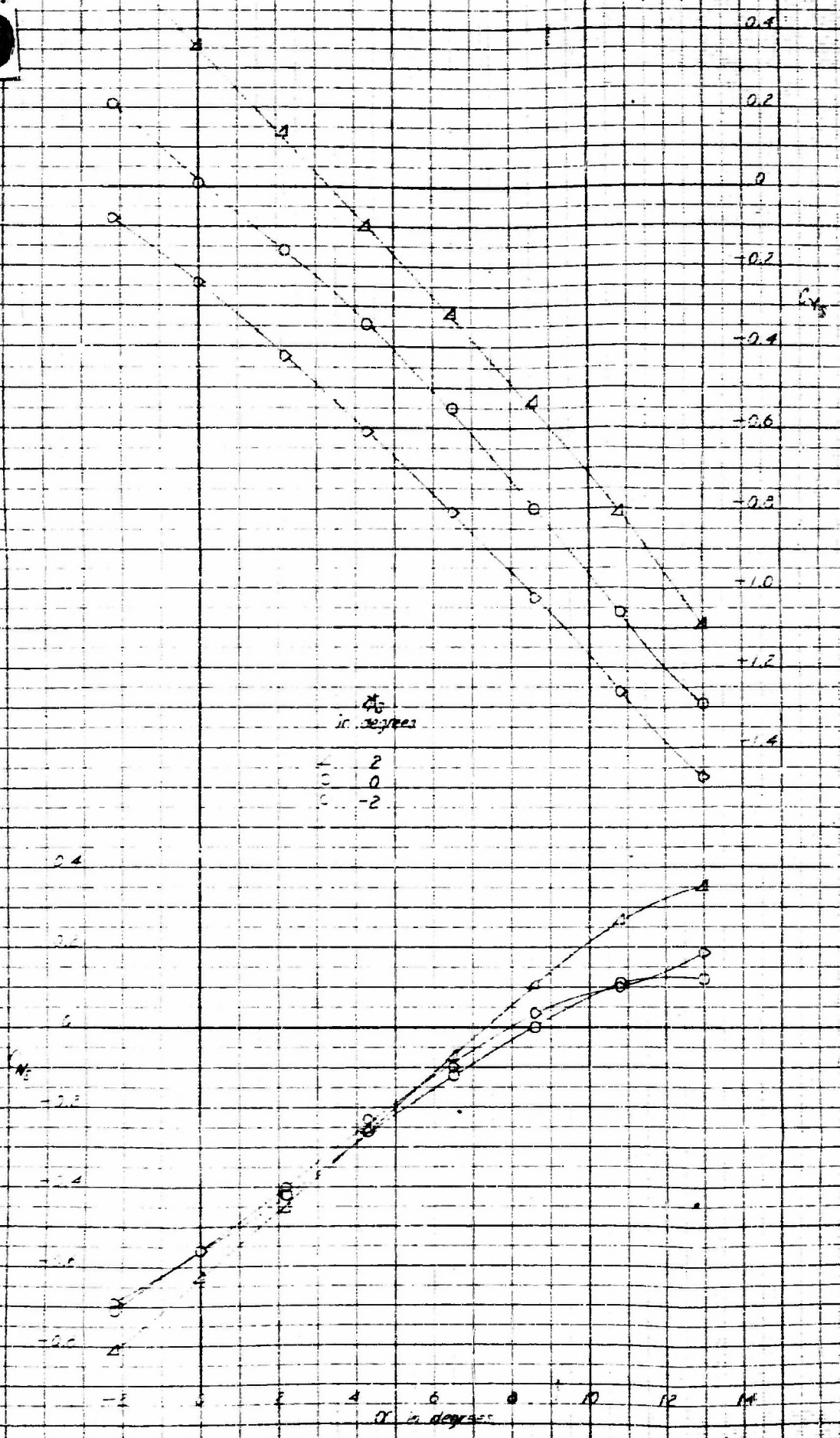


Figure 12 - Aerodynamic Characteristics of a B-17-Scale Model  
 XAAM-N-4 Drive Missile Due to Missile Yaw in the  
 Proximity of a B-17-Scale Model F4U-Airplane  
 at the Toward Station  
 (a)  $z = 1.5$  inch,  $x = 0.5$  inch,  $\theta_s = 0^\circ$ ,  $\alpha = 0^\circ$ ,  $\beta$  in  $^\circ$

FIGURE 12a

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$\alpha$  in degrees

0.16

0.12

0.08

0.04

0

-0.04

-0.08

-0.12

-0.16

-0.20

-0.24

-0.28

-0.32

-0.36

-0.40

-0.44

-0.48

-0.52

-0.56

-0.60

$\psi$   
in degrees

2  
0  
-2

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1

$C_{ms}$

-0.4

2

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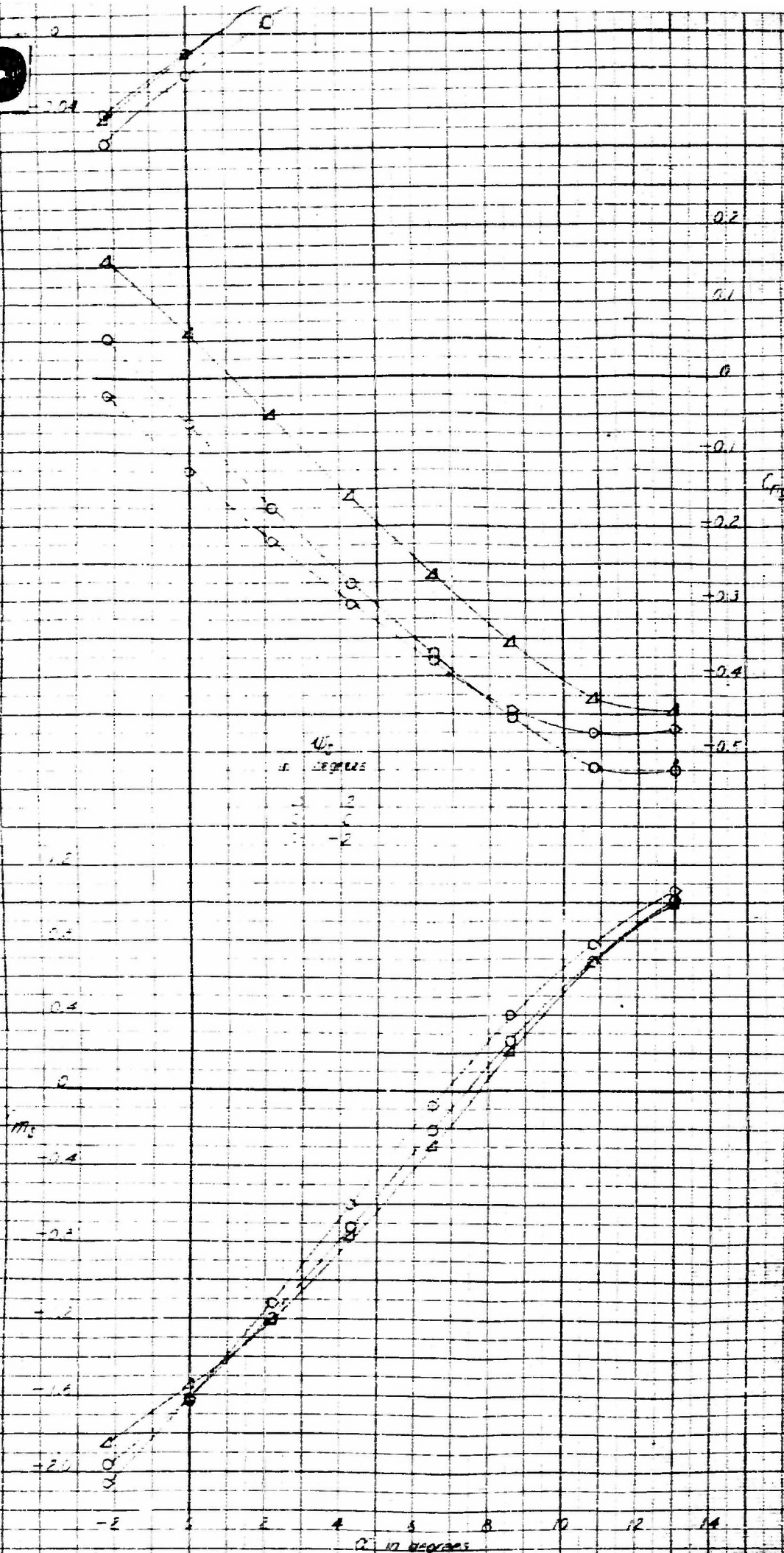


Figure 12 Continued

(b) Concluded

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$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0.0

0.6

0.4

0.2

0

-0.2

-0.4

$C_{YB}$

-0.6

-0.8

-1.0

-1.2

-1.4

-1.6

-1.8

$\beta$   
in degrees  
3  
6  
-3

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0.6

0.4

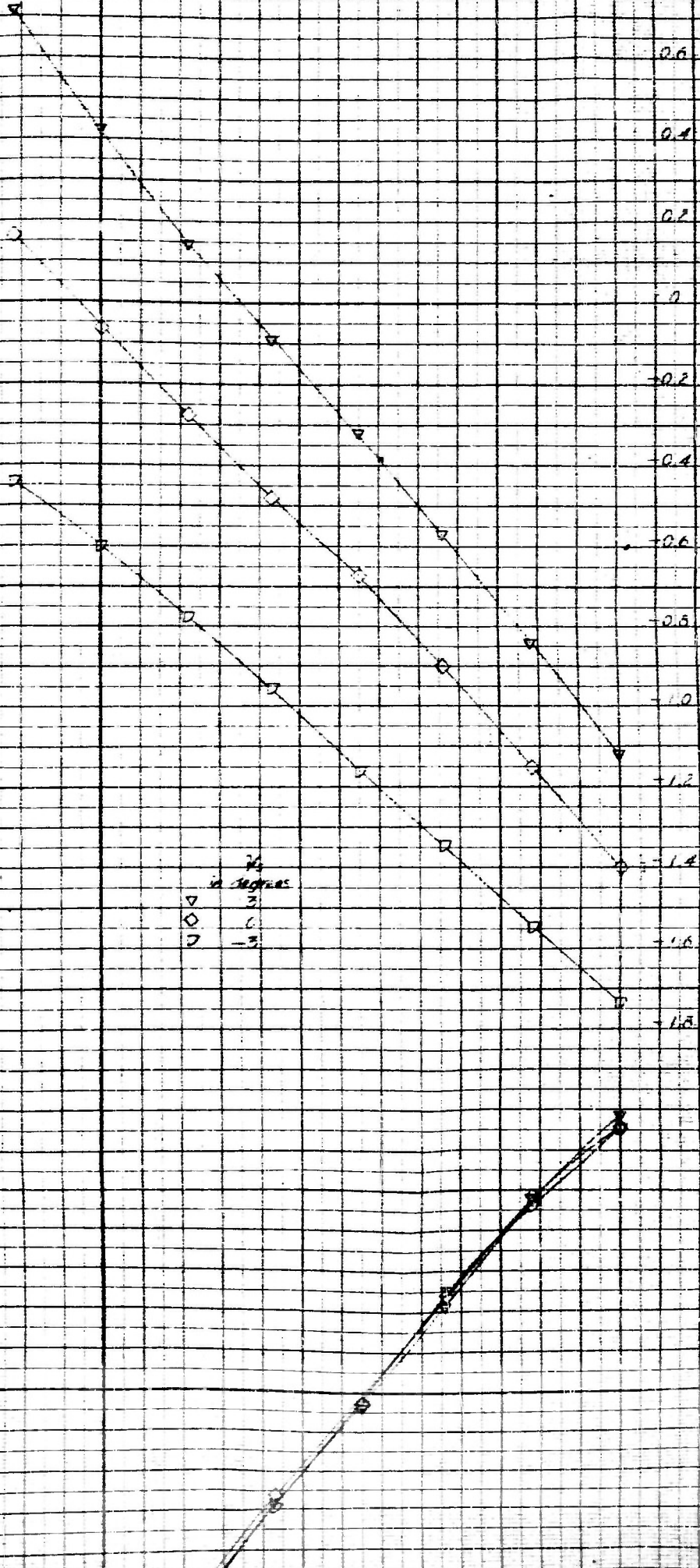
0.2

0

-0.2

$C_{YB}$

-0.4





2

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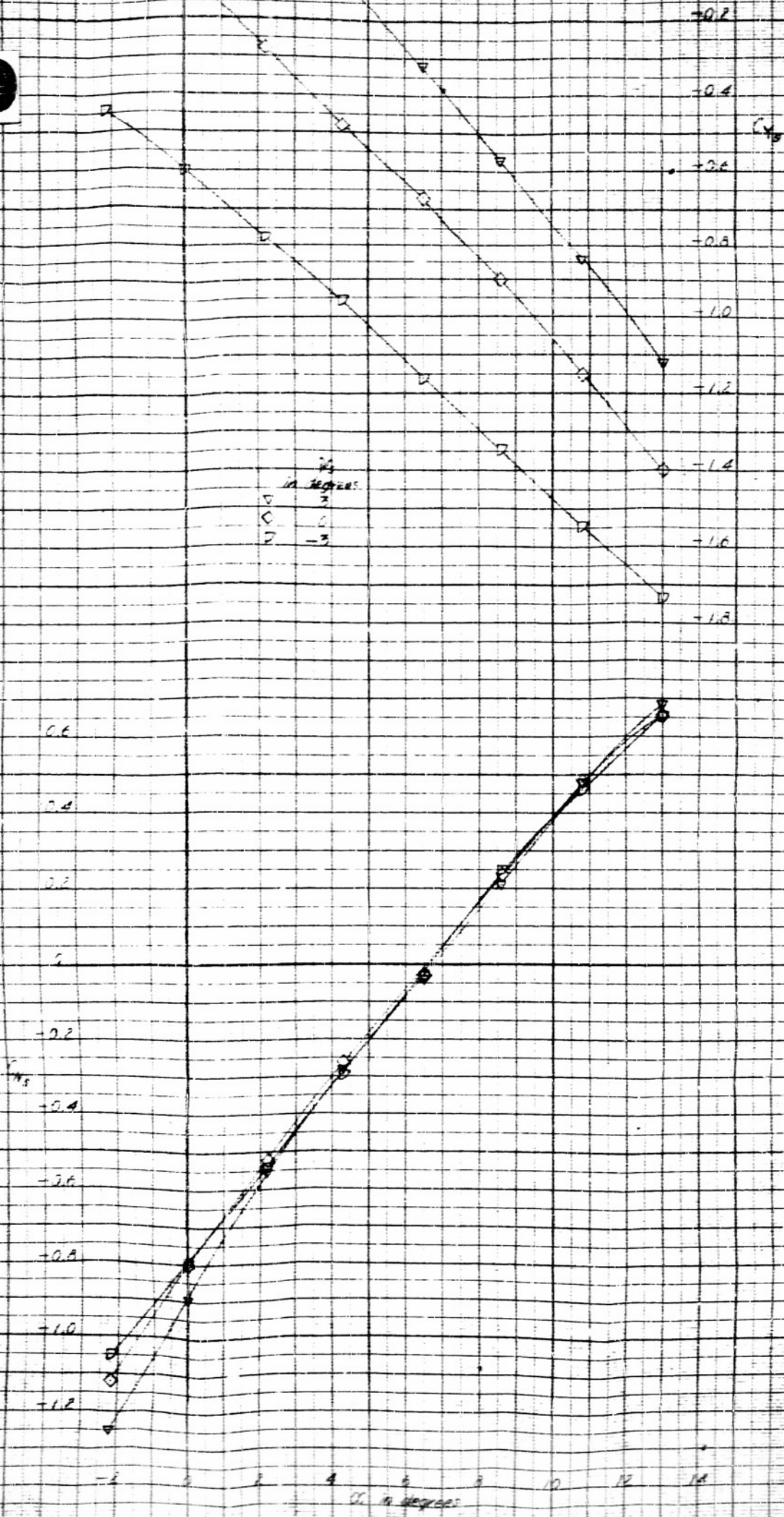


Figure 12 (Continued)

(b)  $z = 0.750$ ,  $x = 0.12$  inches,  $S_1 = 11$ ,  $\beta = 0$ , Pyralon GP

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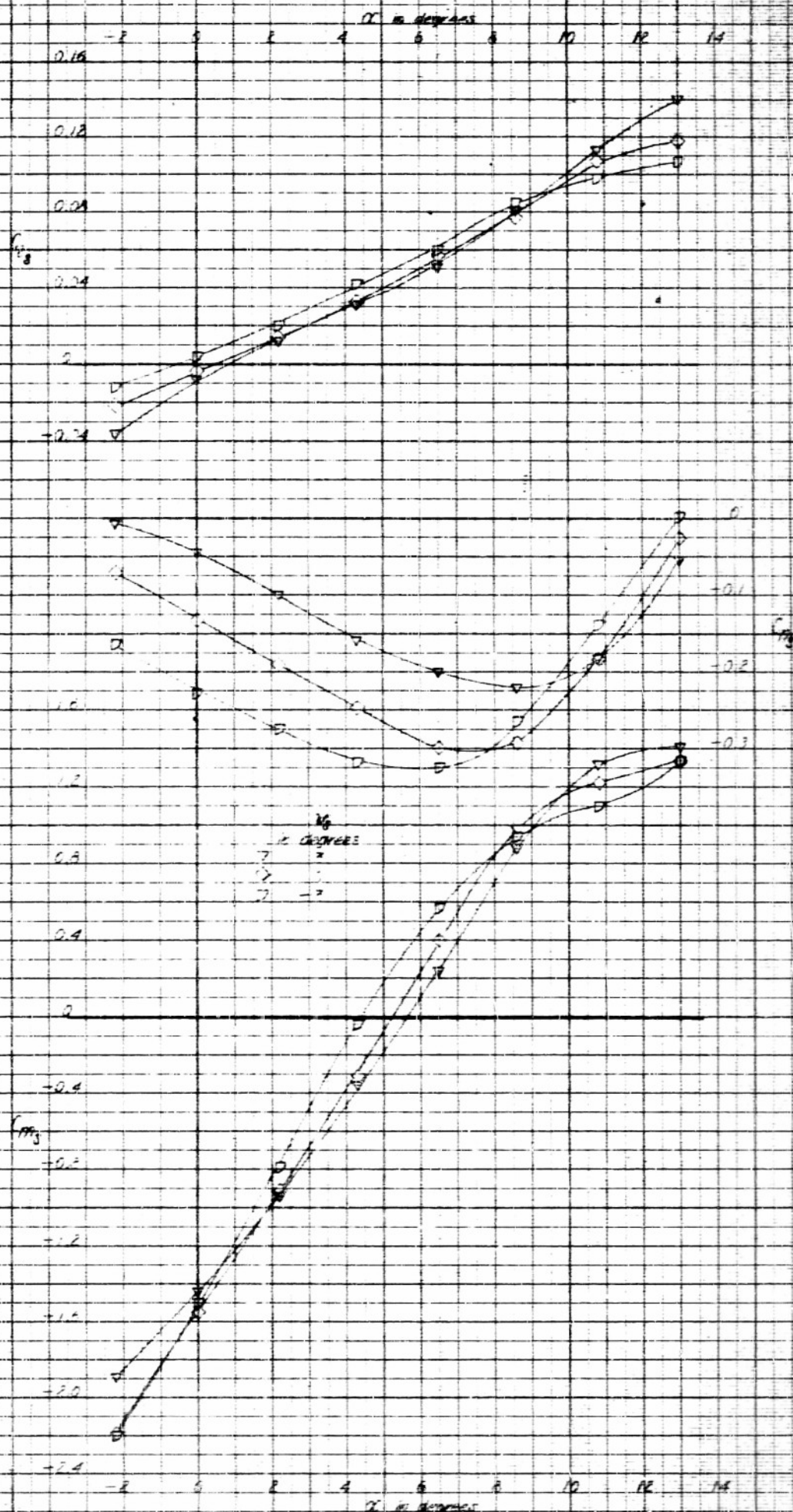


Figure 12 (Continued)

to Concluded

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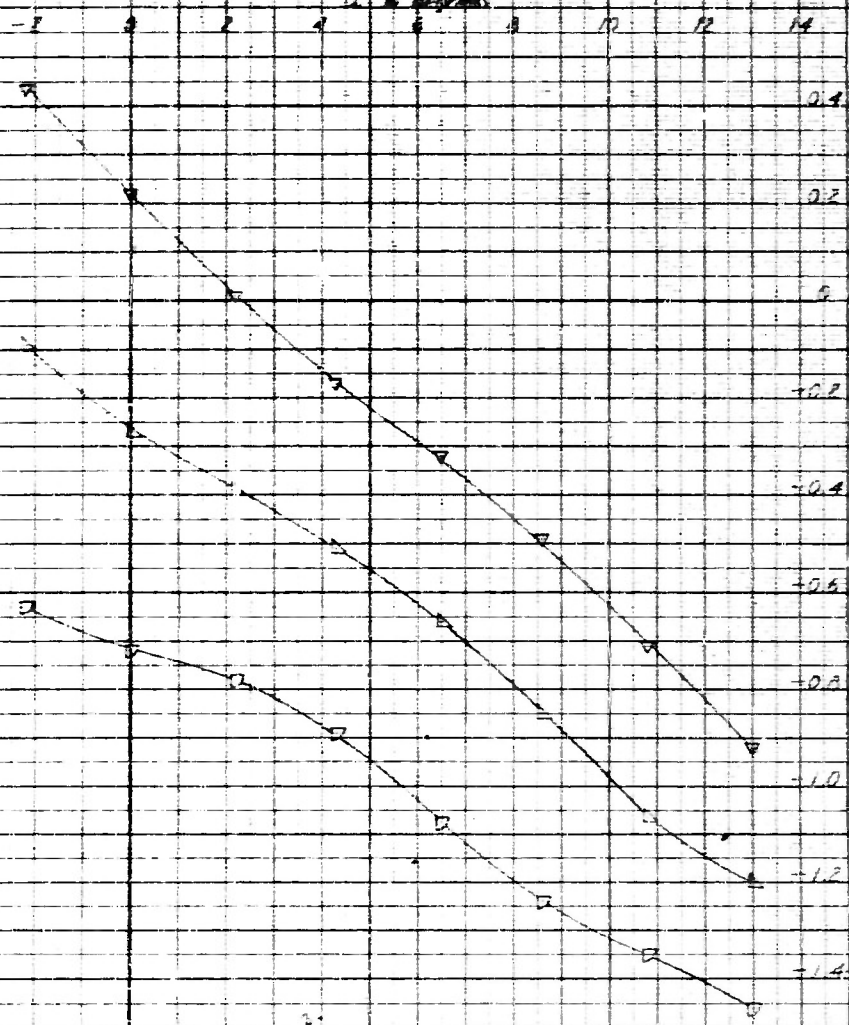
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$\alpha$  in degrees

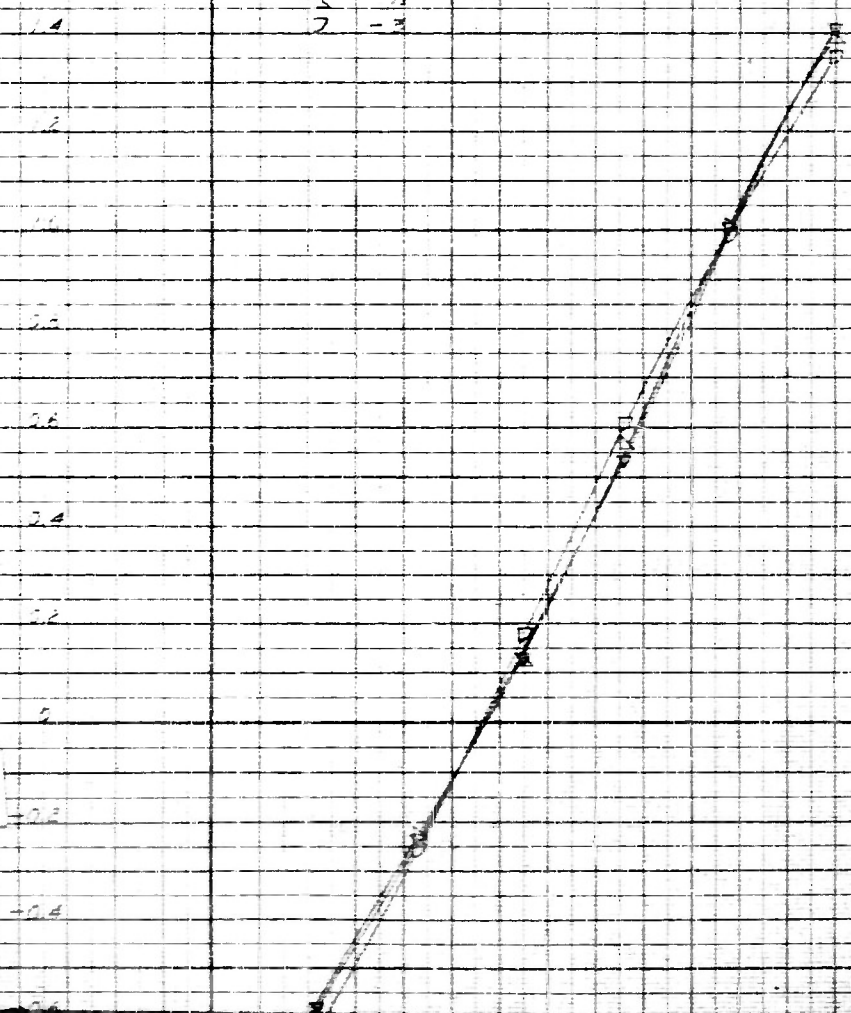
AB00604



$\alpha$  in degrees

7 7  
2 2  
2 -2

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2

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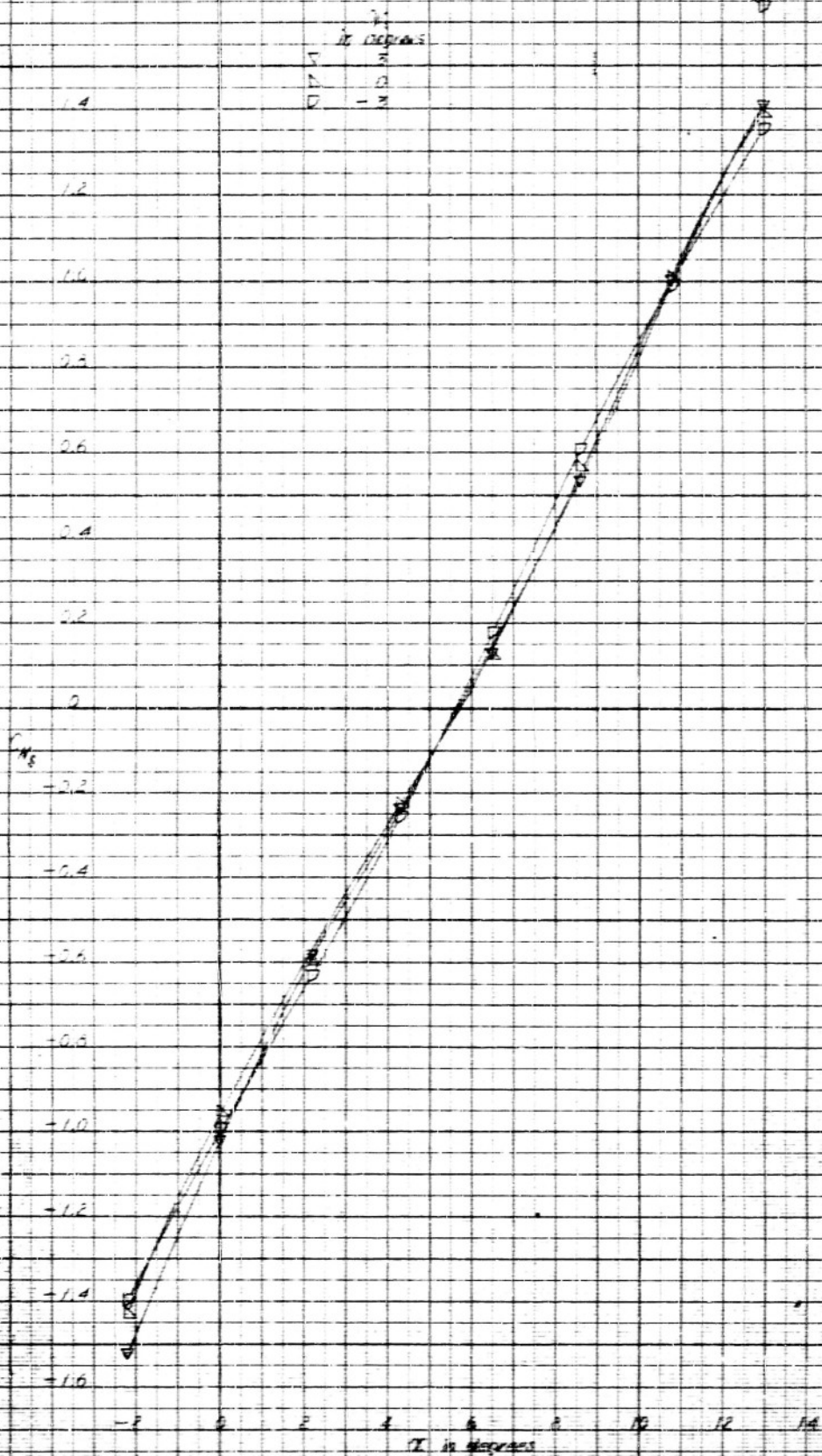


Figure 12 (Continued)

(c)  $R=0.1$  to 1.2,  $T$  in degrees,  $W=0$ ,  $R=0$ ,  $R$  from 0 to 1.2

FIGURE 12.C

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FIGURE 12 (Continued)

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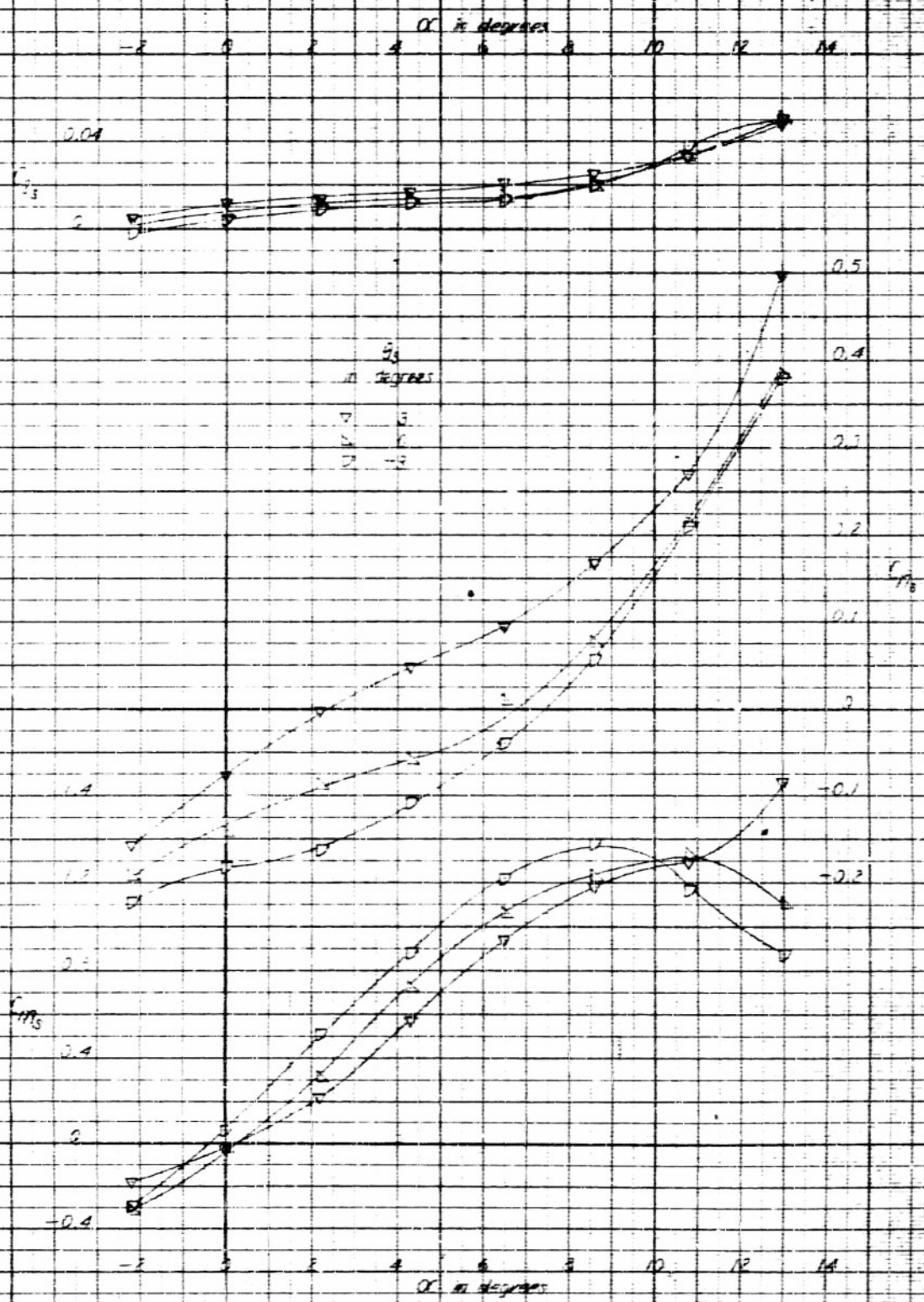


Figure 12 (Continued)  
(c) Continued

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0.10 DEGREES

-2 0 2 4 6 8 10 12 14

1.0

0.8

0.6

0.4

0.2

0

G<sub>1</sub>

-0.2

-0.4

-0.6

-0.8

-1.0

-1.2

-1.4

-1.6

-1.8

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1.6

1.4

1.2

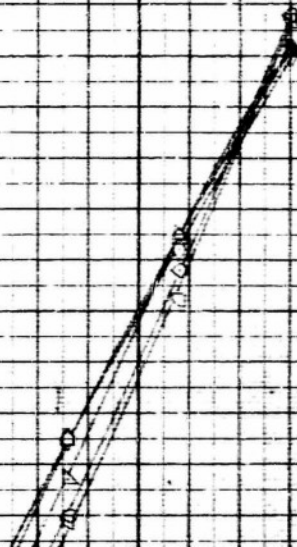
1.0

0.8

0.6

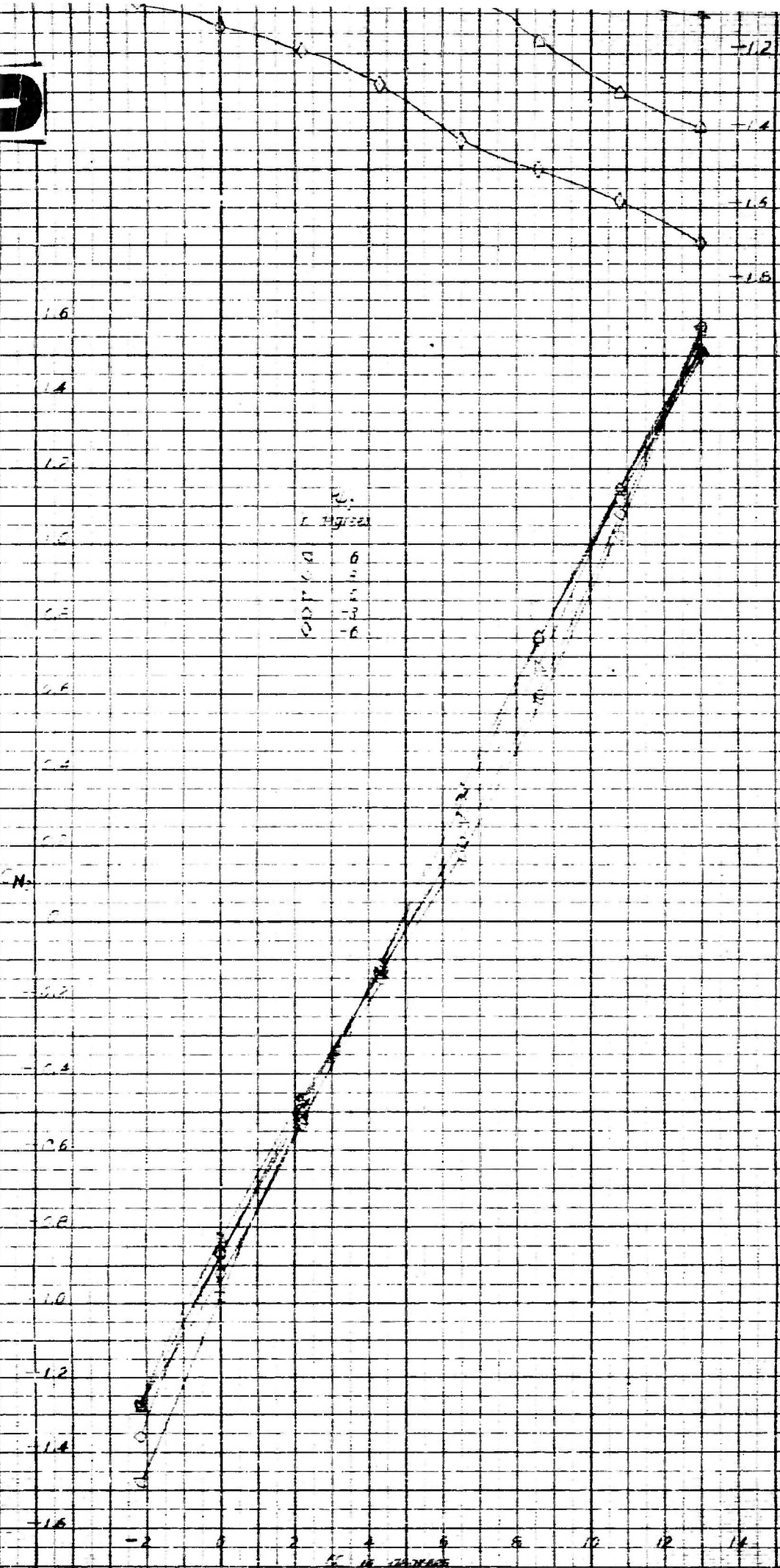
0.10 DEGREES

0.10  
0.05  
0.02  
0.01  
0.00



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$\theta$	$\gamma$
0	6
1	5
2	4
3	3
4	2

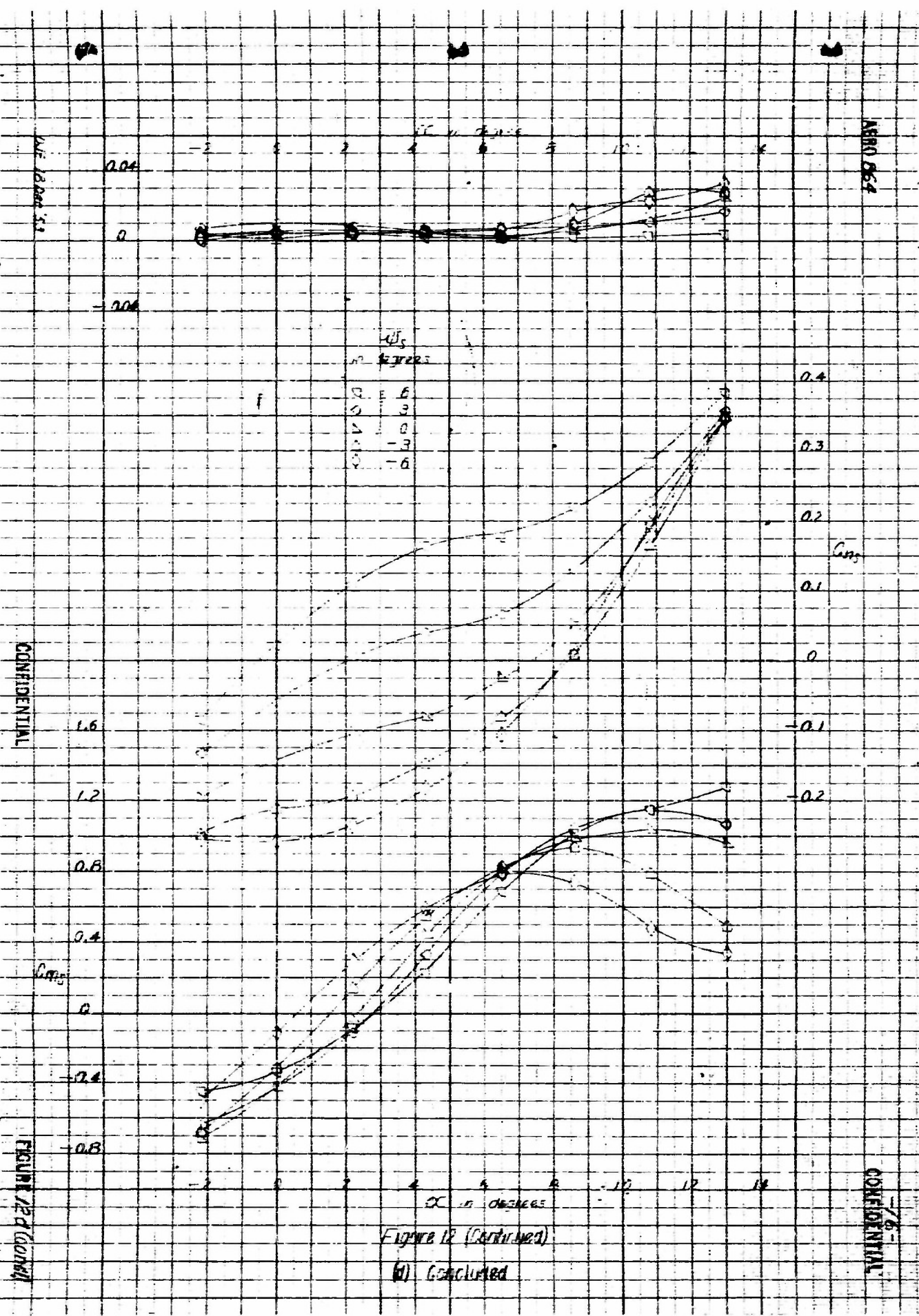
Figure 12 (Continued)

(1)  $z = 0$  inch,  $y = 13.26$  inches,  $\theta_2 = 0$ ,  $\theta = 0$ ,  $P_{\text{pilot}} = 0$

FIGURE 12

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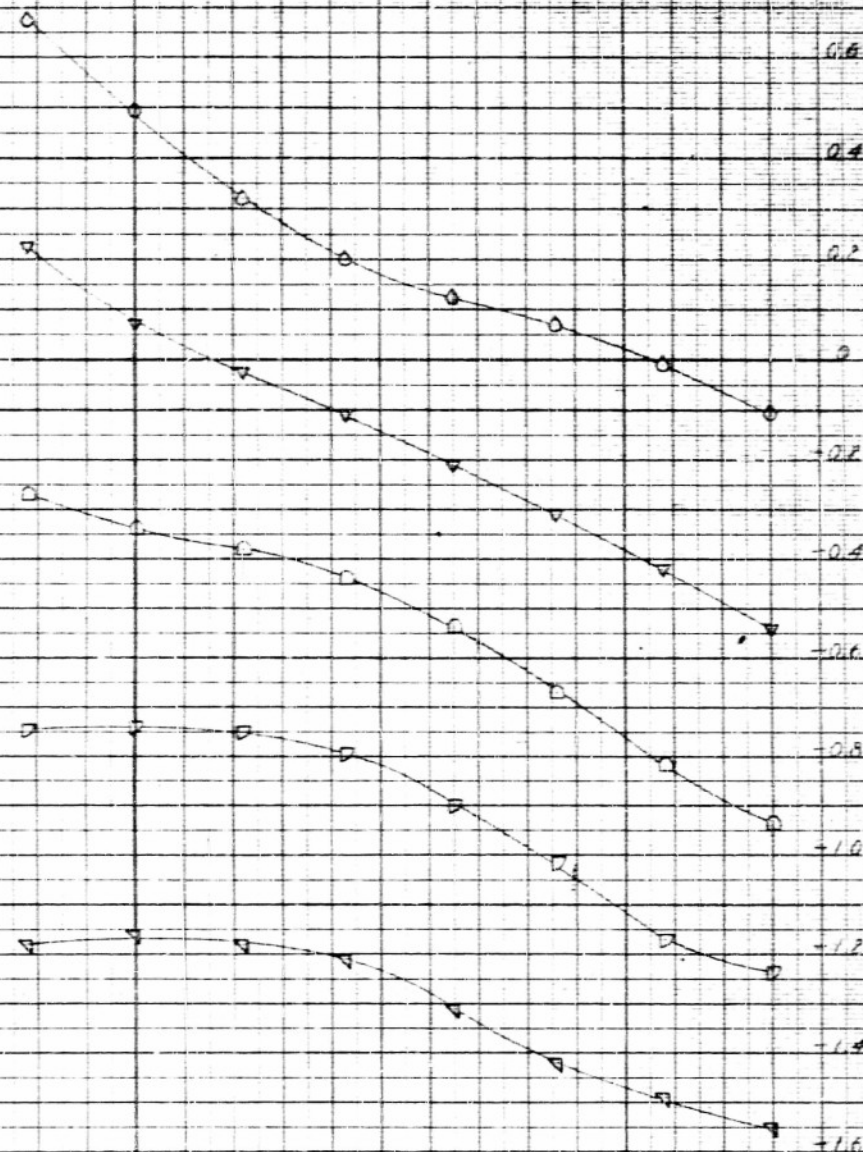




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$\alpha$  in degrees



$\psi_0$   
in degrees

0 6  
 $\Delta$  3  
 $\square$  0  
 $\nabla$  -3  
 $\nabla$  -6

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

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2

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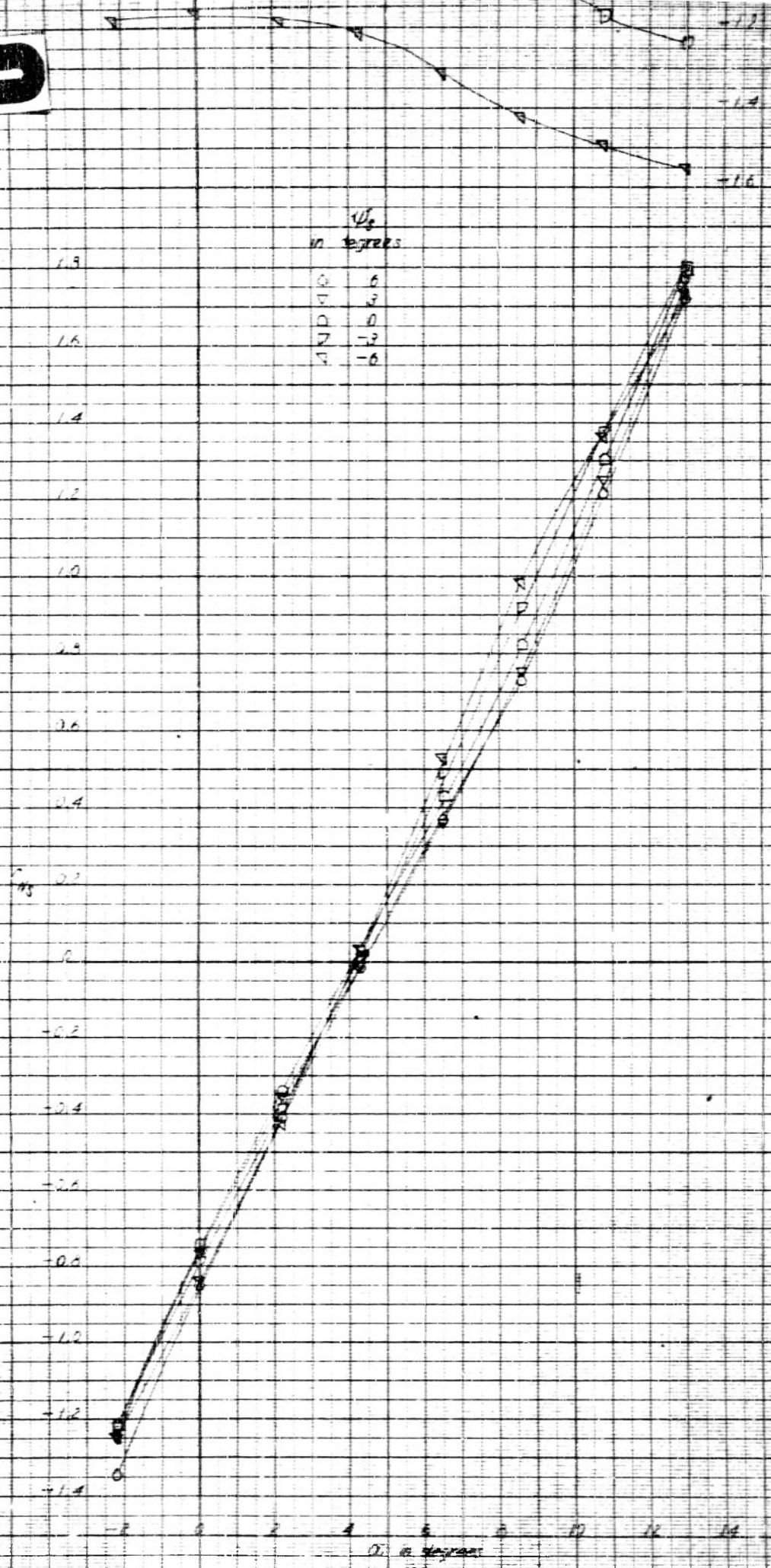


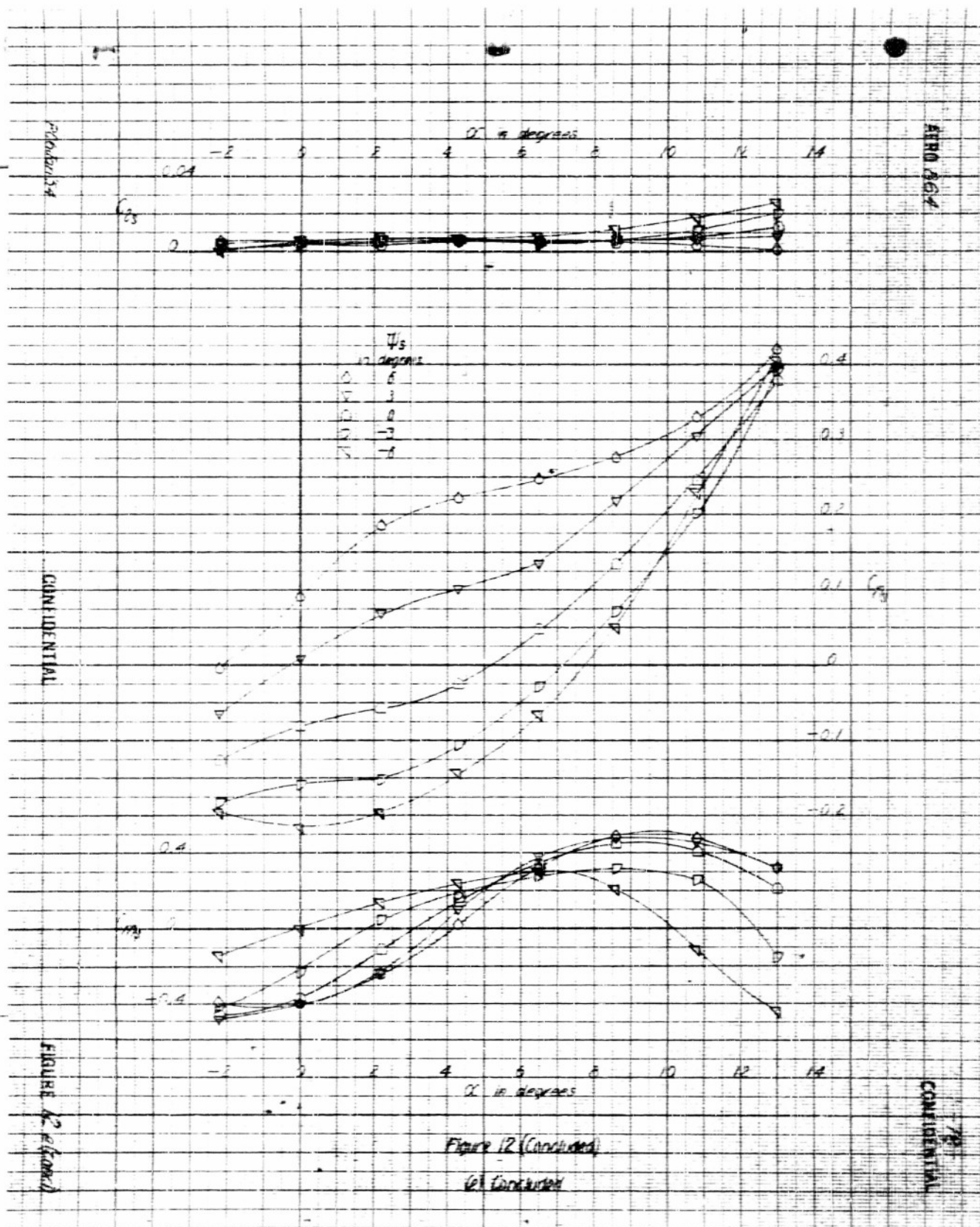
Figure 12 (Continued)

(a)  $z=0$  inch,  $r=14.35$  inches,  $\theta_0=0$ ,  $\psi_0=0$ ,  $\rho_0=0$

FIGURE 12

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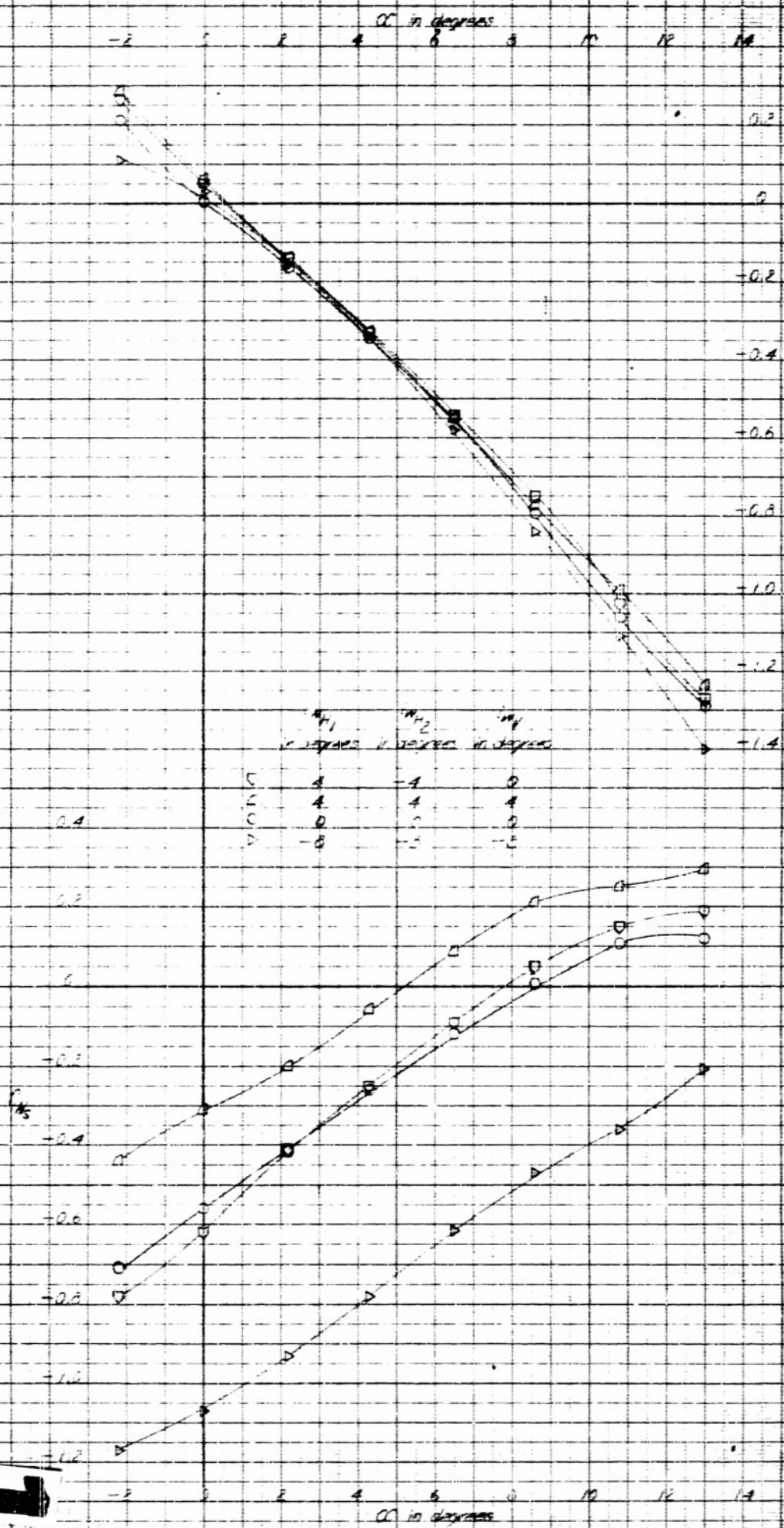


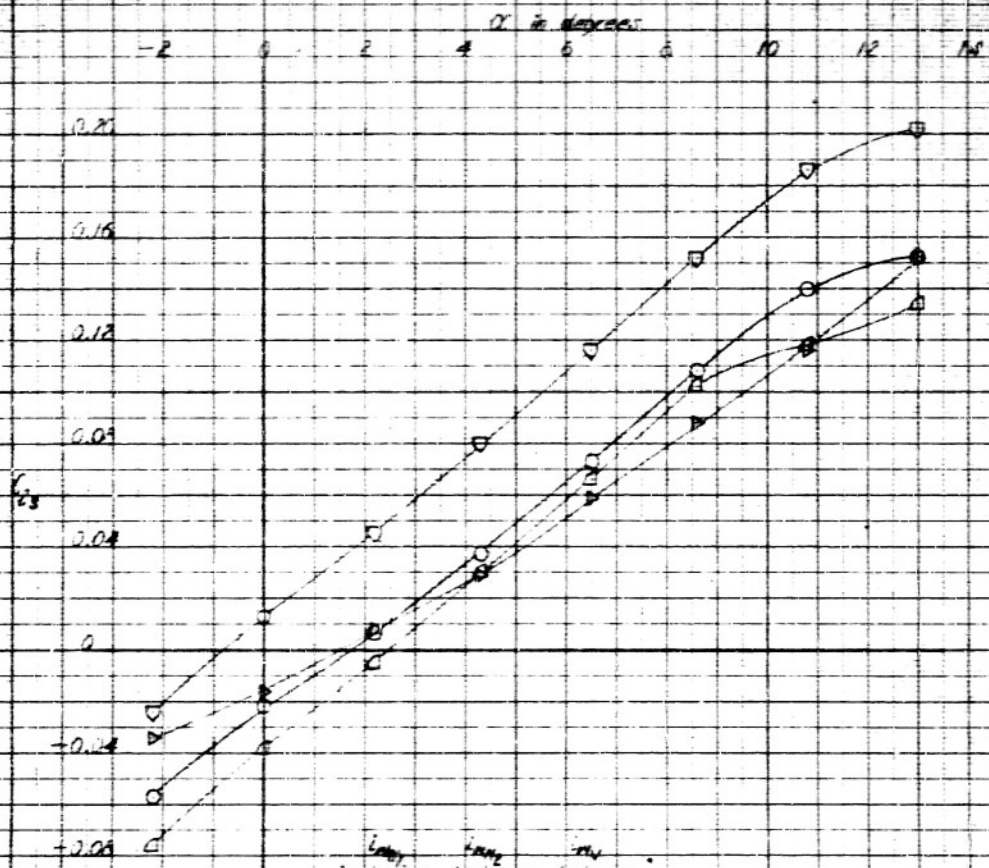
Figure 13 - Aerodynamic Characteristics of a 1/17 Scale Model XAAM-VI-4





FIGURE 51

FIGURE 52



	$\alpha_{max}$ in degrees	$\alpha_{min}$ in degrees	$\alpha_{avg}$ in degrees
$\square$	4	-4	0
$\square$	4	4	4
$\circ$	0	0	0
$\nabla$	-6	-6	-6

0.1

0

+0.1

$C_D$

-0.1

-0.3

-0.4

-0.5

-0.6

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1.6

1.2

0.8

0.4

2

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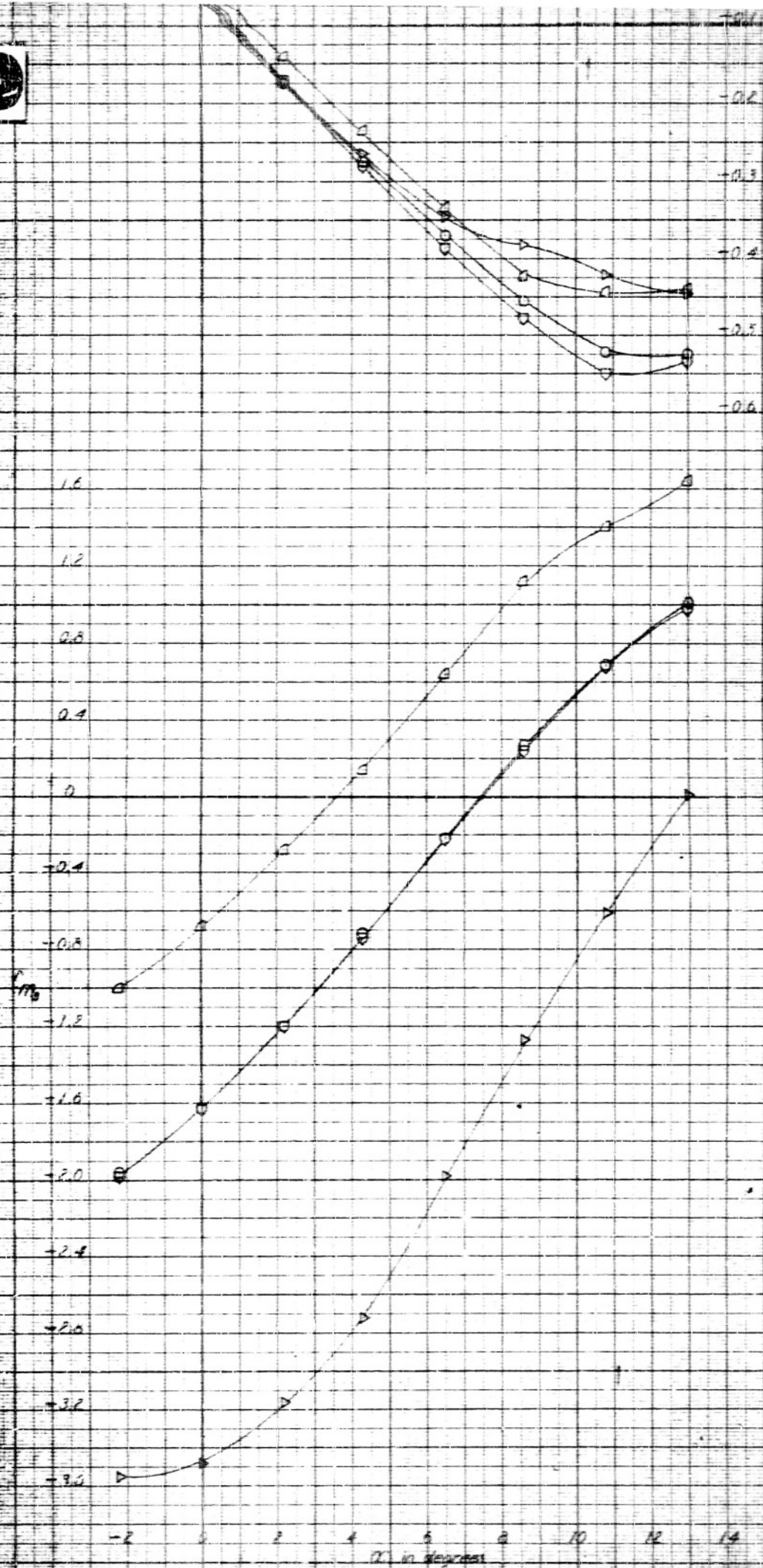
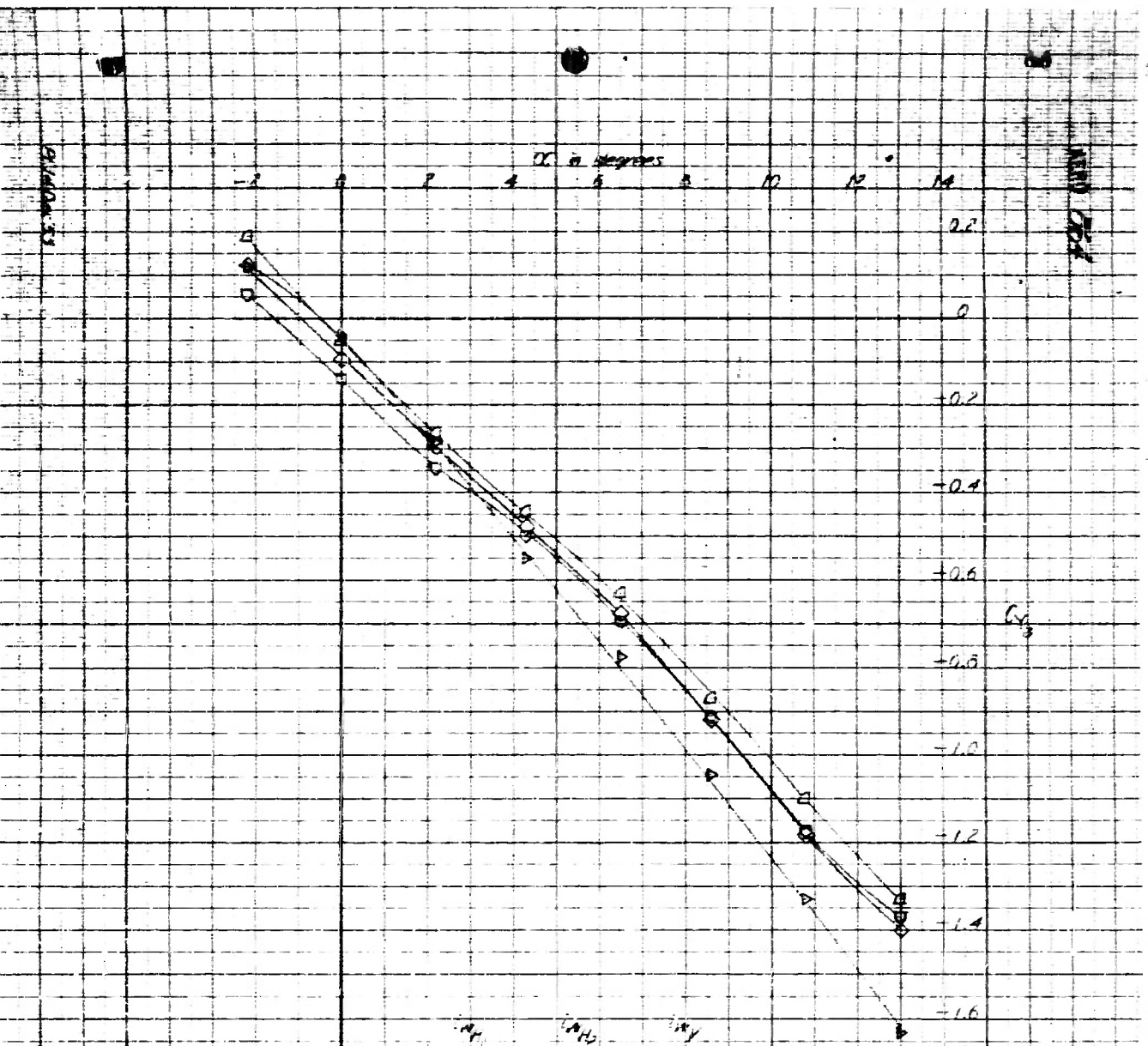


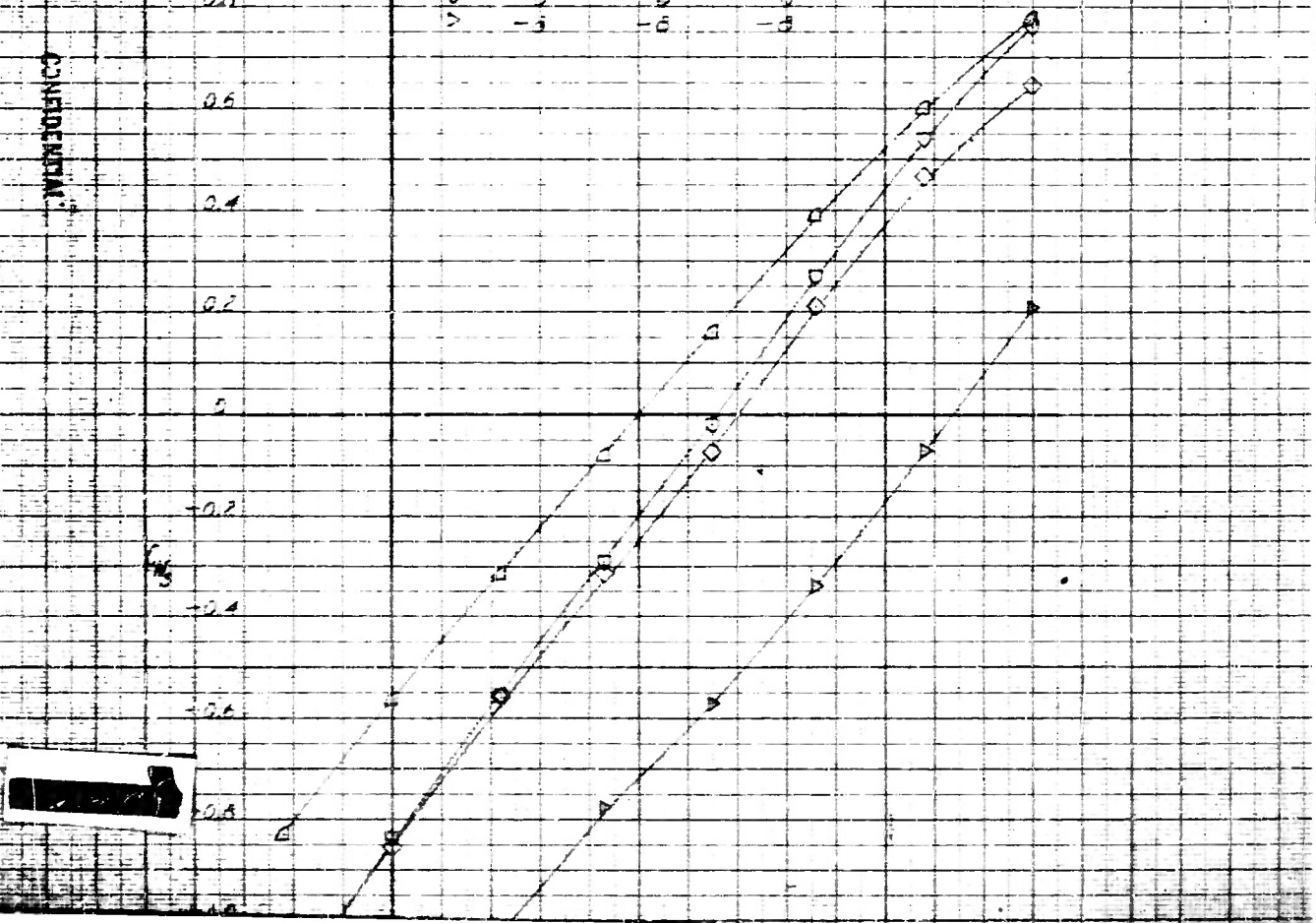
FIGURE 13 (continued)  
(a) Continued

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	$\alpha_H$	$\alpha_{H_2}$	$\alpha_Y$
DU	4	-4	0
U	4	4	4
DU	0	0	0
A	-3	-6	-3



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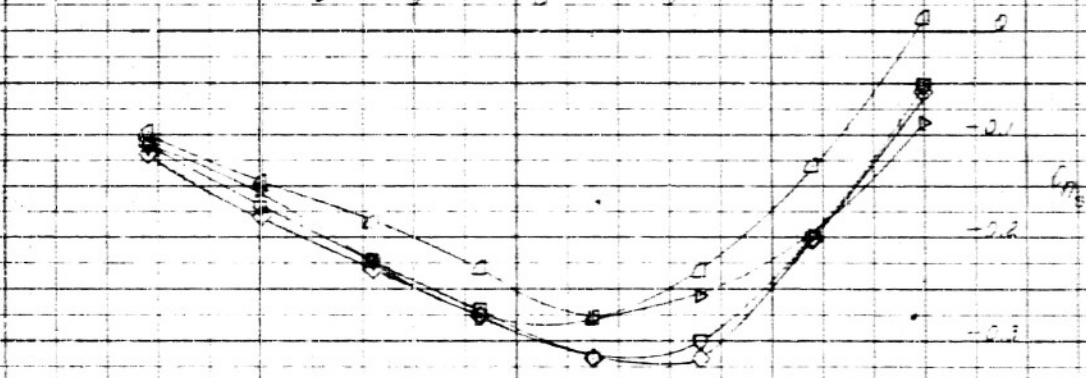
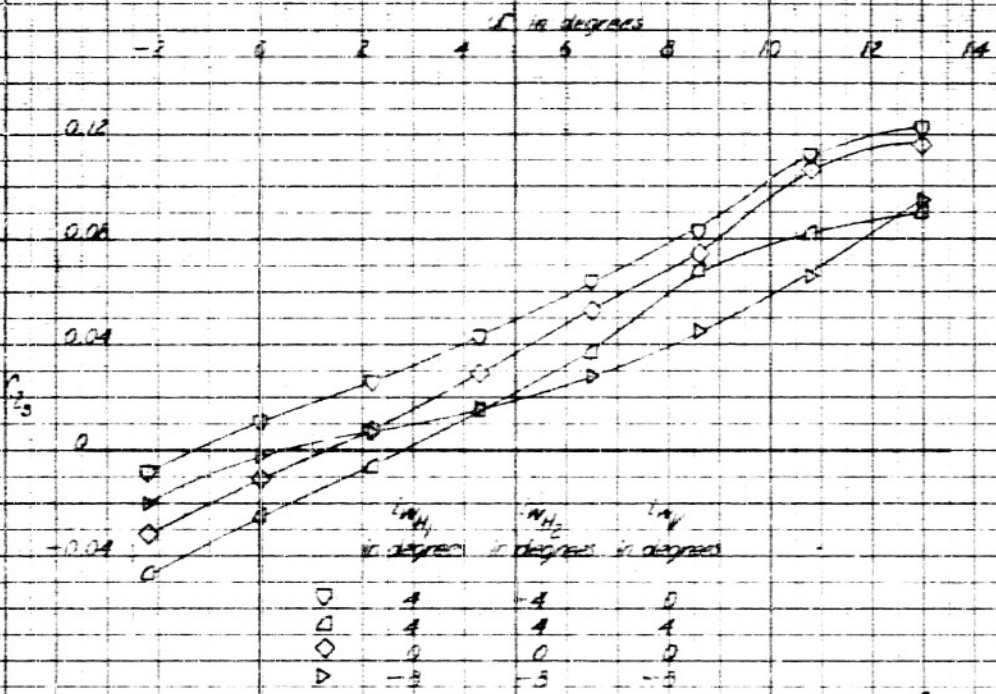
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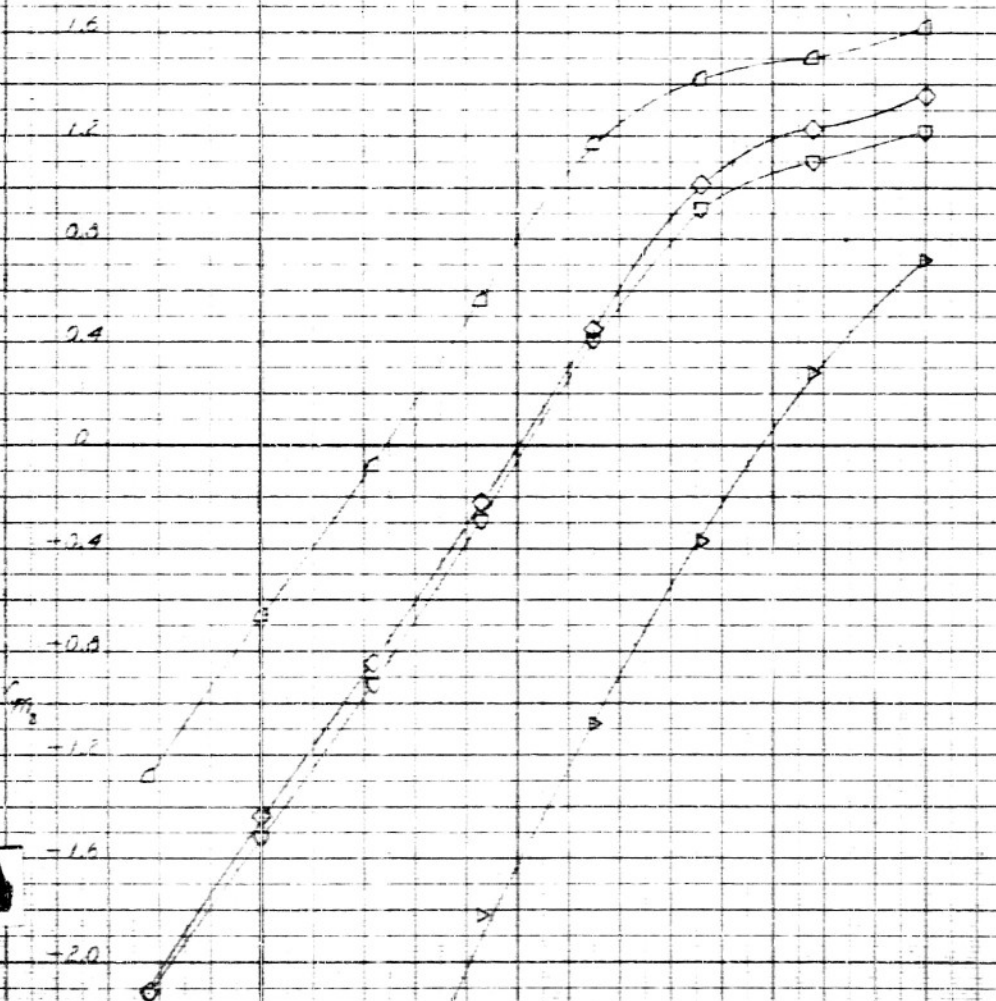
for  $F = 0$  kN,  $x = 5.12$  mm,  $\theta = 0^\circ$ ,  $\psi = 0^\circ$ ,  $\phi = 0^\circ$ ;  $\theta$  and  $\psi$  are

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2

	$\alpha_{H1}$ in degrees	$\alpha_{H2}$ in degrees	$\alpha_{H3}$ in degrees
○	4	-4	0
□	4	4	4
◇	0	0	0
▽	-8	-8	-8

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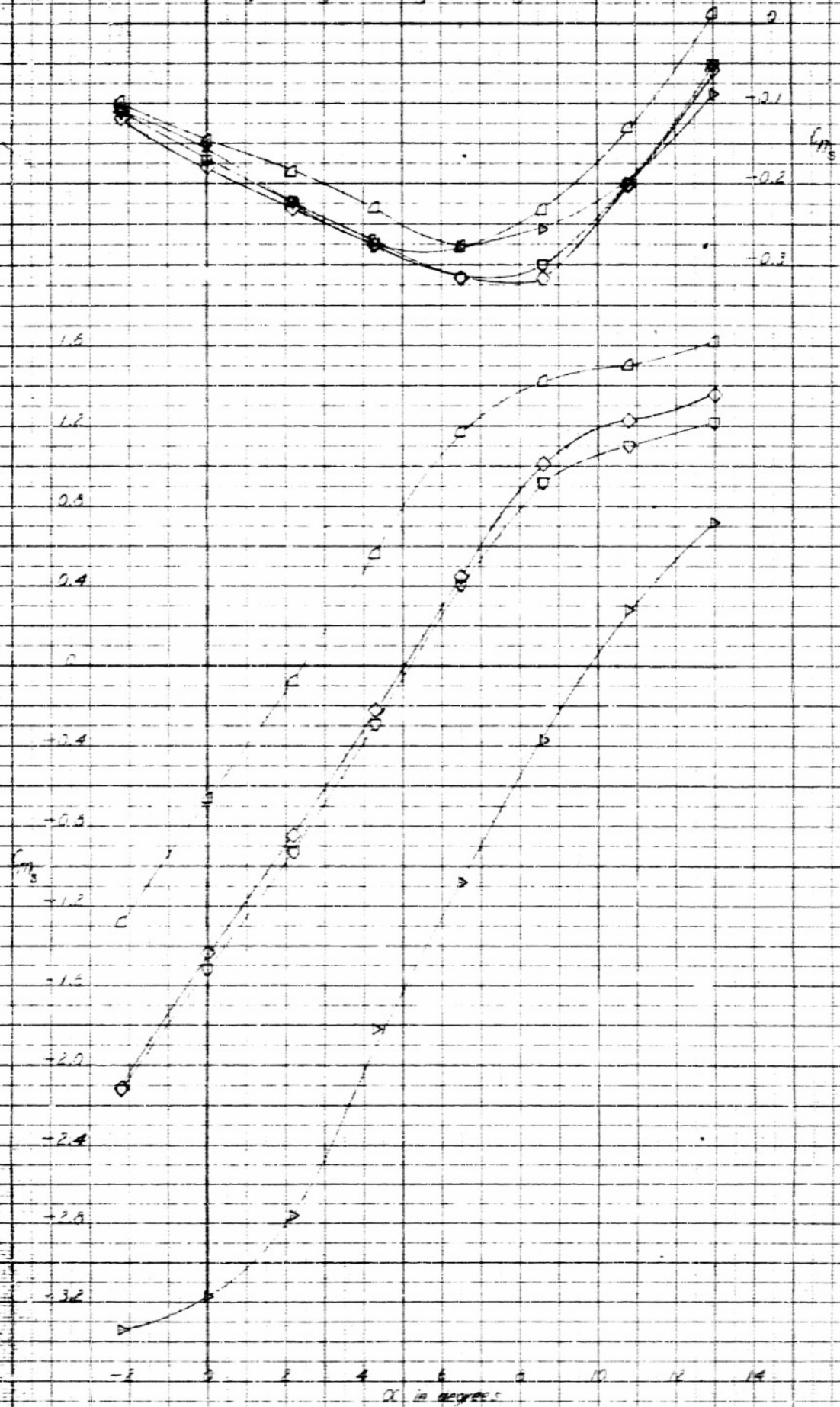


Figure 1.3 (Continued)  
(a) Continued

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$\gamma$  in degrees

-2 0 2 4 6 8 10 12 14

0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2  
-1.4  
-1.6  
-1.8

$C_{Y_3}$

$\gamma_{M_1}$  in degrees  $\gamma_{M_2}$  in degrees  $\gamma_{M_3}$  in degrees

D	4	-4	0
C	3	4	4
C	2	0	0
A	-3	-3	-3

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1.6  
1.4  
1.2  
1.0  
0.8  
0.6  
0.4  
0.2

$C_{M_3}$



2

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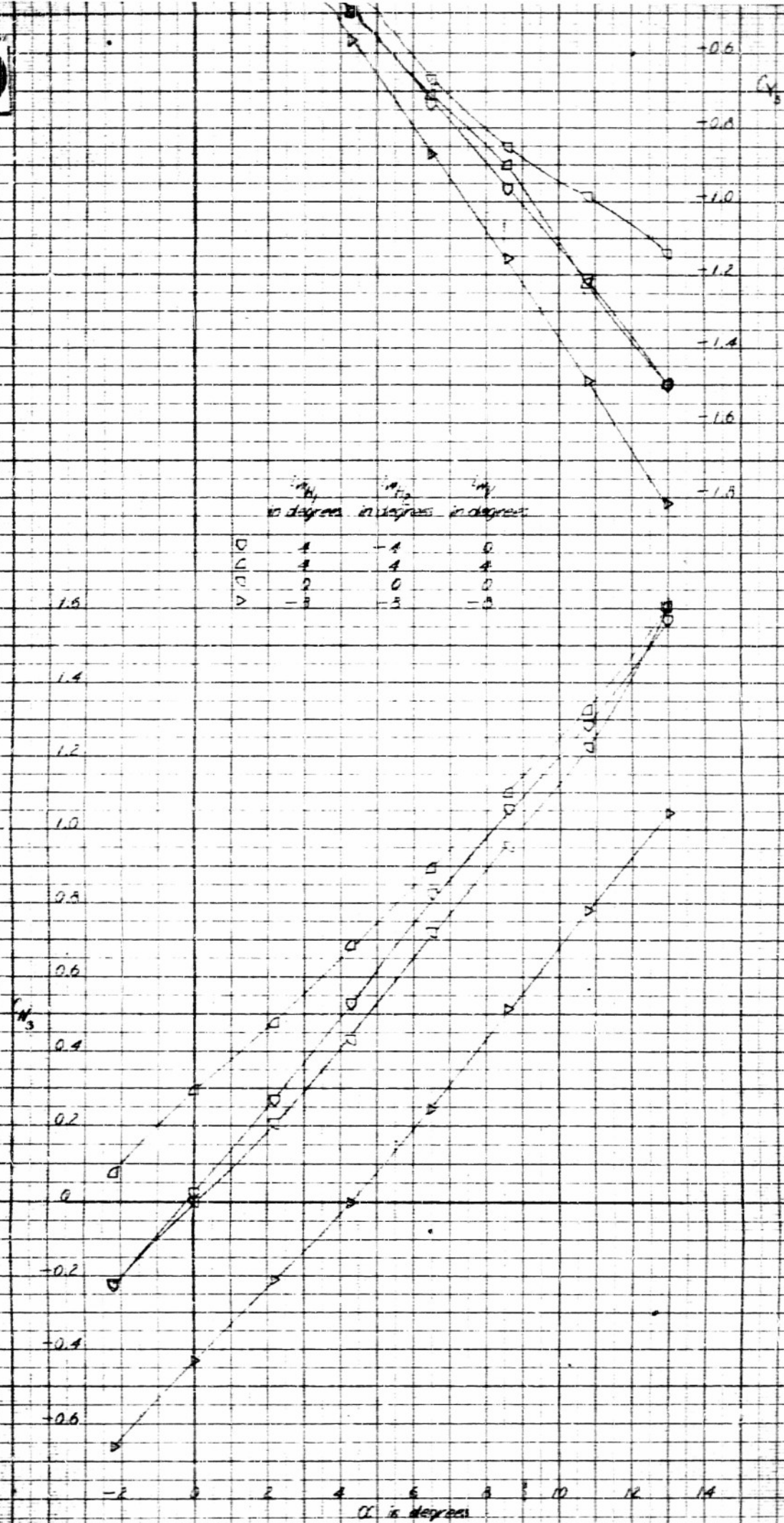


Figure 13 (Continued)

(c)  $Z=0$  inch,  $X=6.12$  inches,  $\theta_3=6^\circ$ ,  $\eta_{H_3}=0^\circ$ ,  $\eta_H=0^\circ$ , Region CII

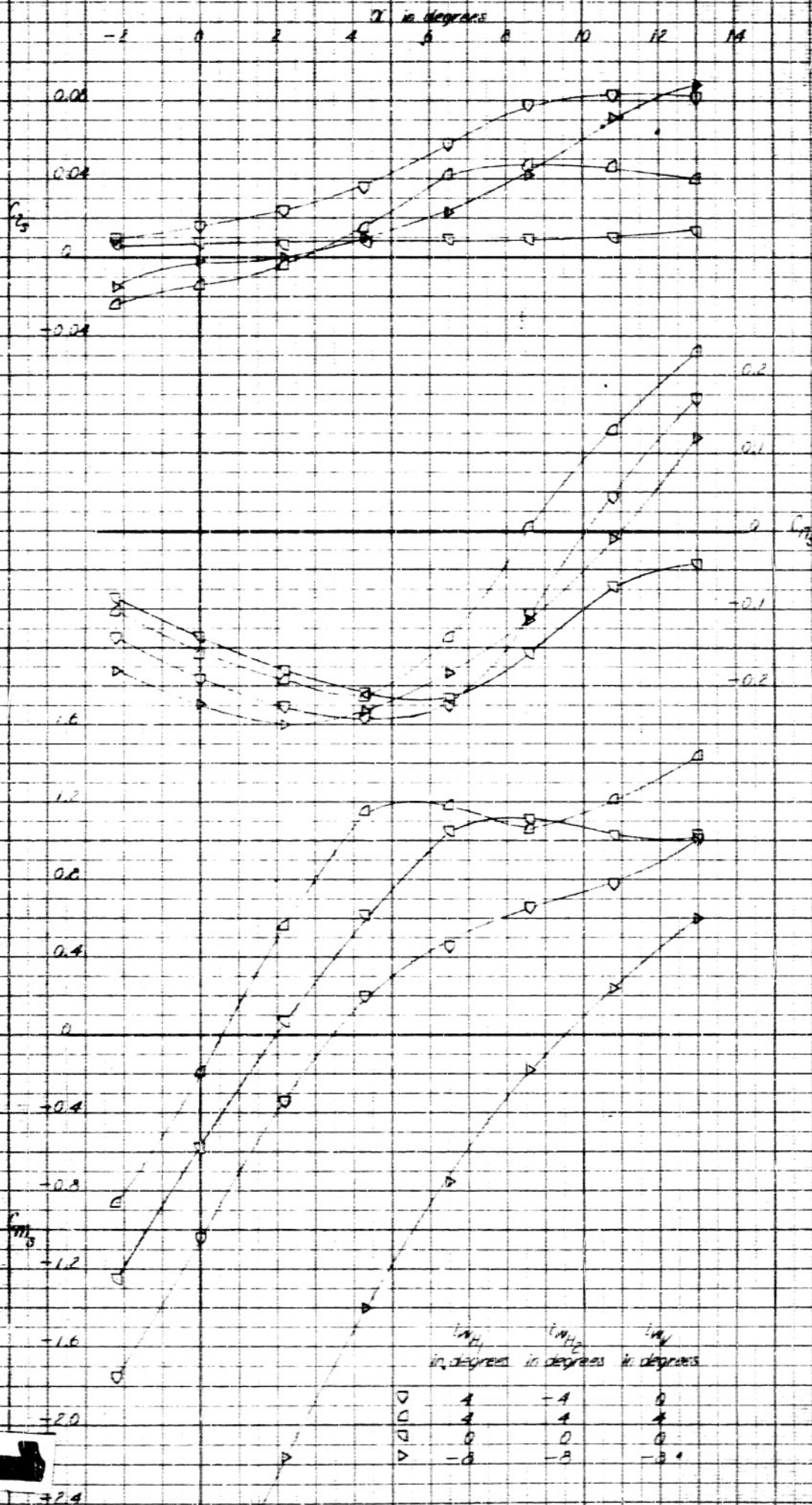
FIGURE 13

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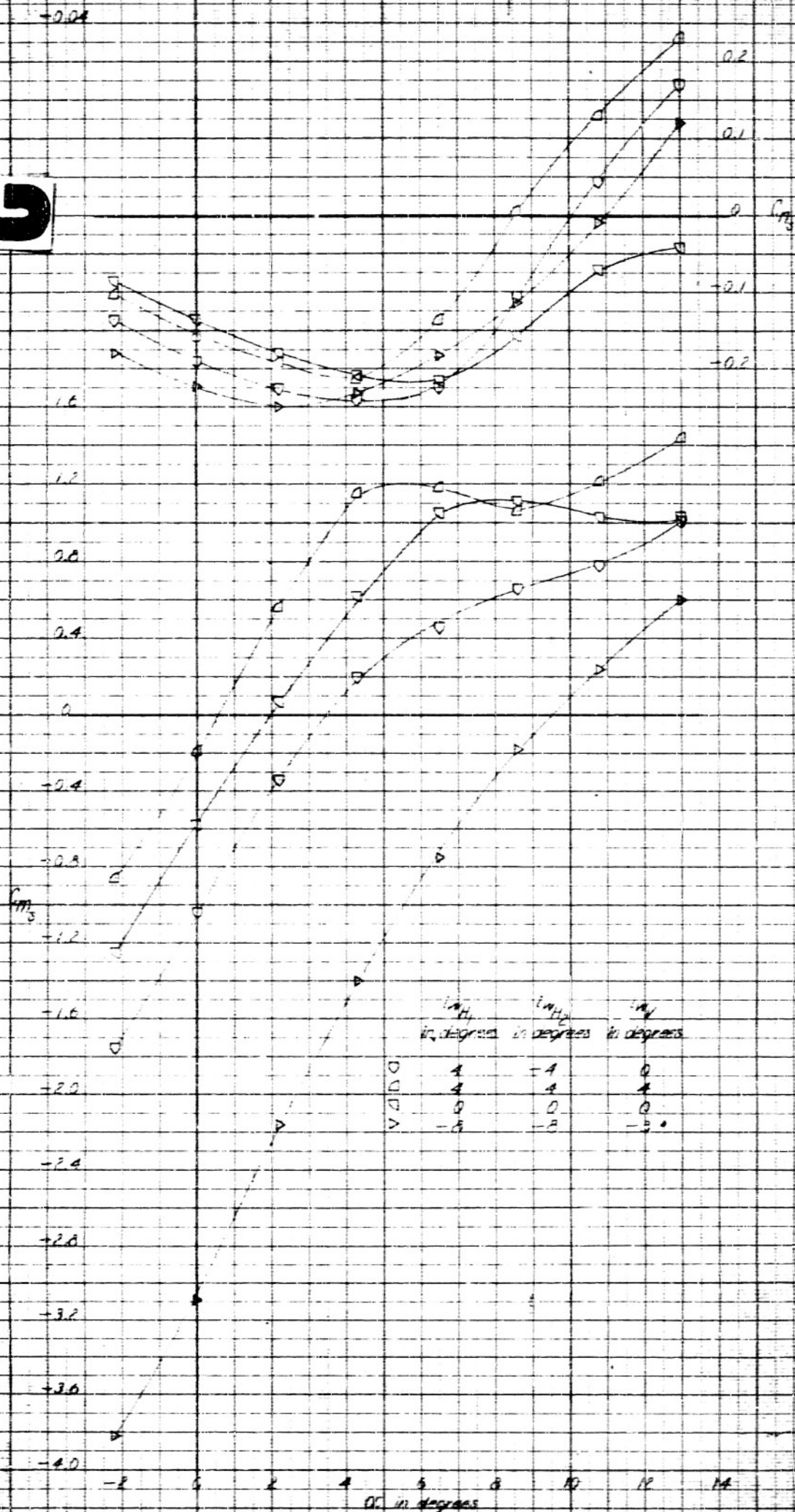


FIGURE 13 (Continued)

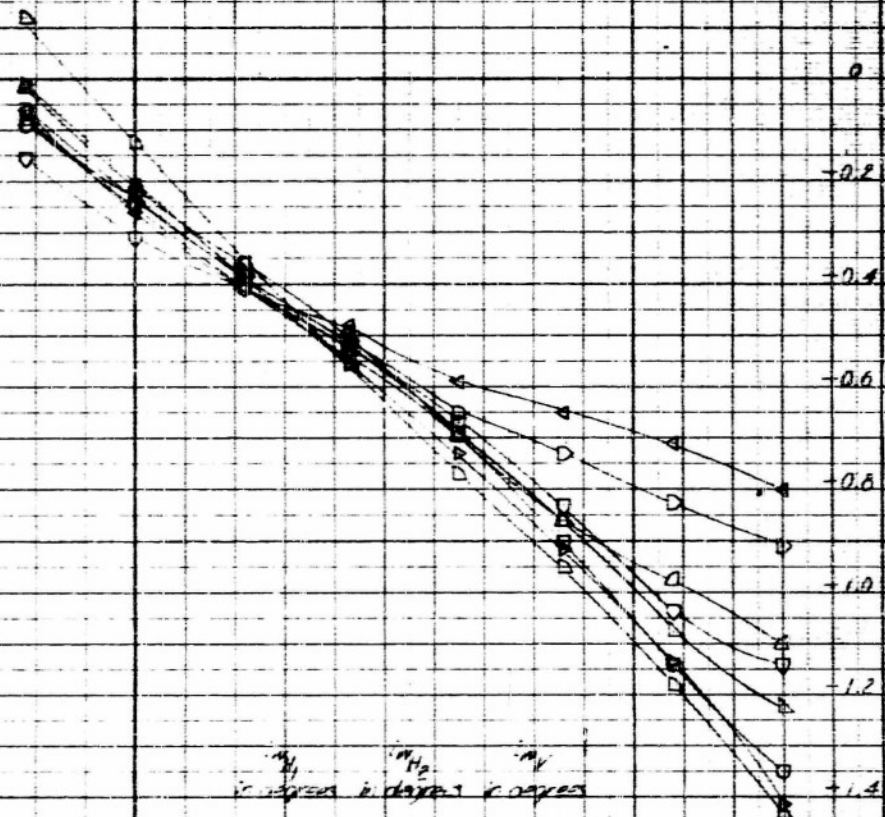
Figure 13 (Continued)  
(b) Continued

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$\alpha$  in degrees



$\alpha_1$ in degrees	$\alpha_2$ in degrees	$\alpha_3$ in degrees
4	-4	9
8	12	12
8	8	5
4	4	4
0	0	0
-4	-4	-4
-8	-8	-8
-12	-12	-12

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**2**

0	4	-4	0
0	12	12	12
0	8	8	8
0	4	4	4
0	0	0	0
0	-4	-4	-4
0	-8	-8	-8
0	-12	-12	-12

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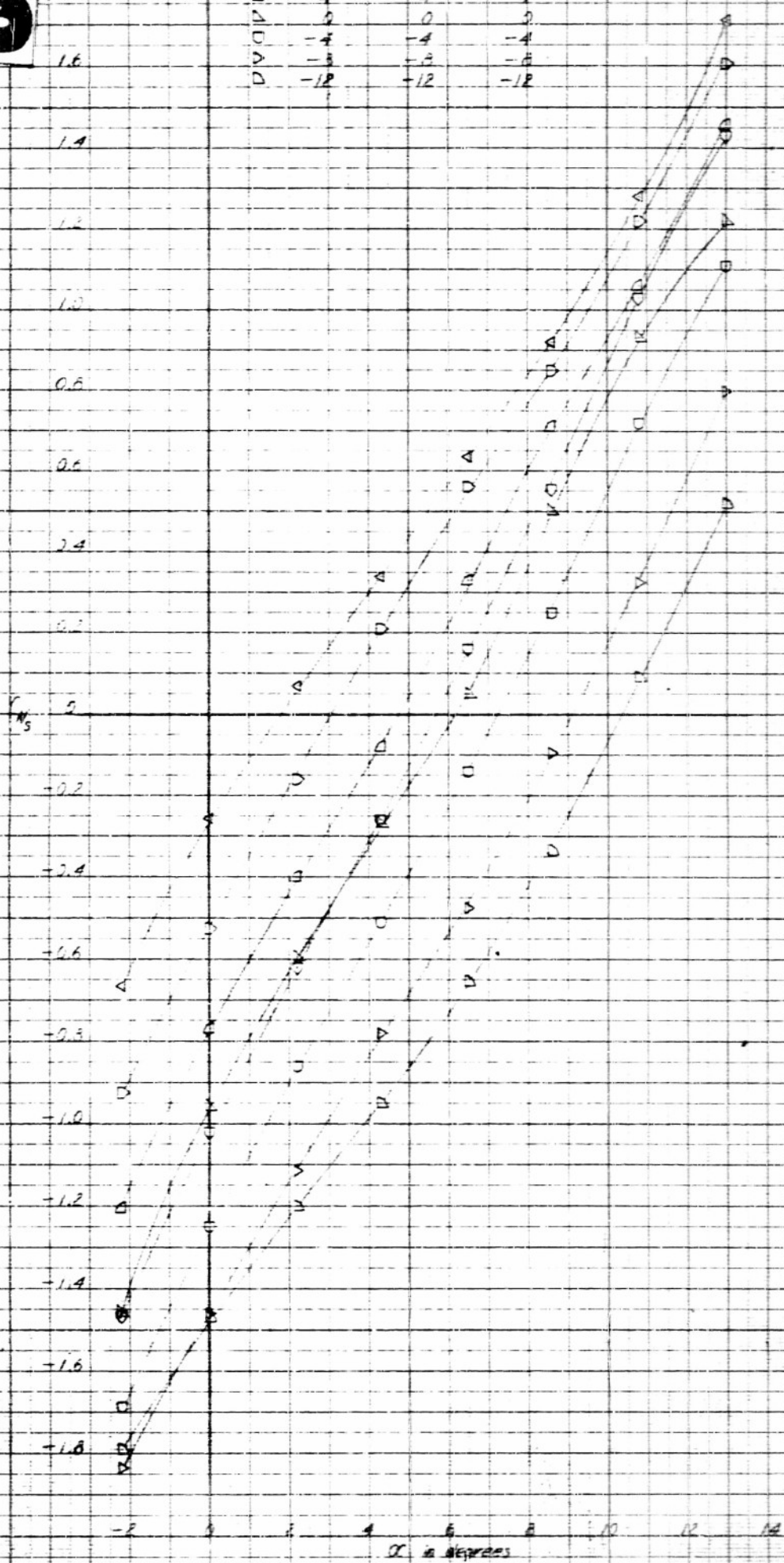


FIGURE 13A

Figure 13 (continued)

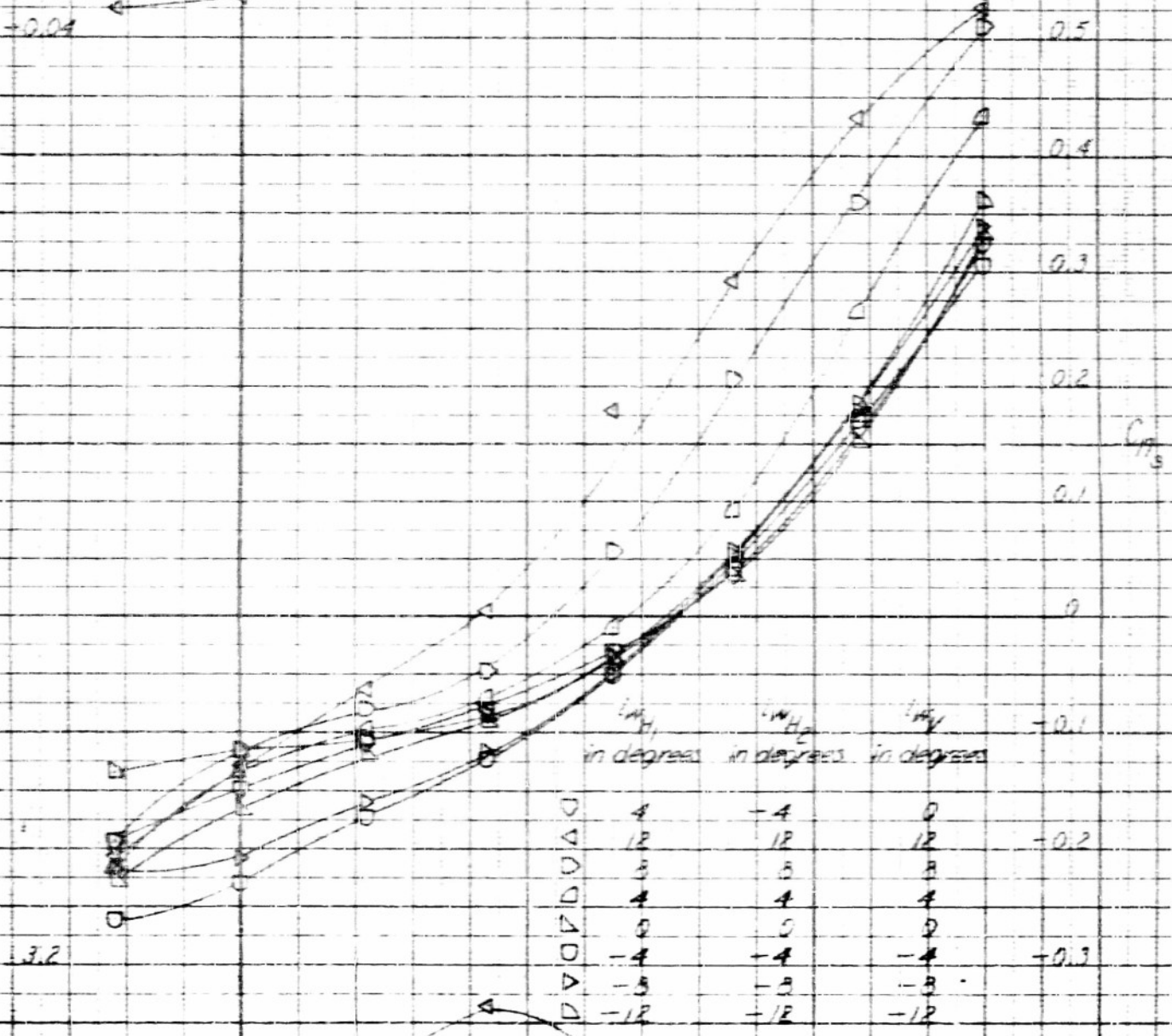
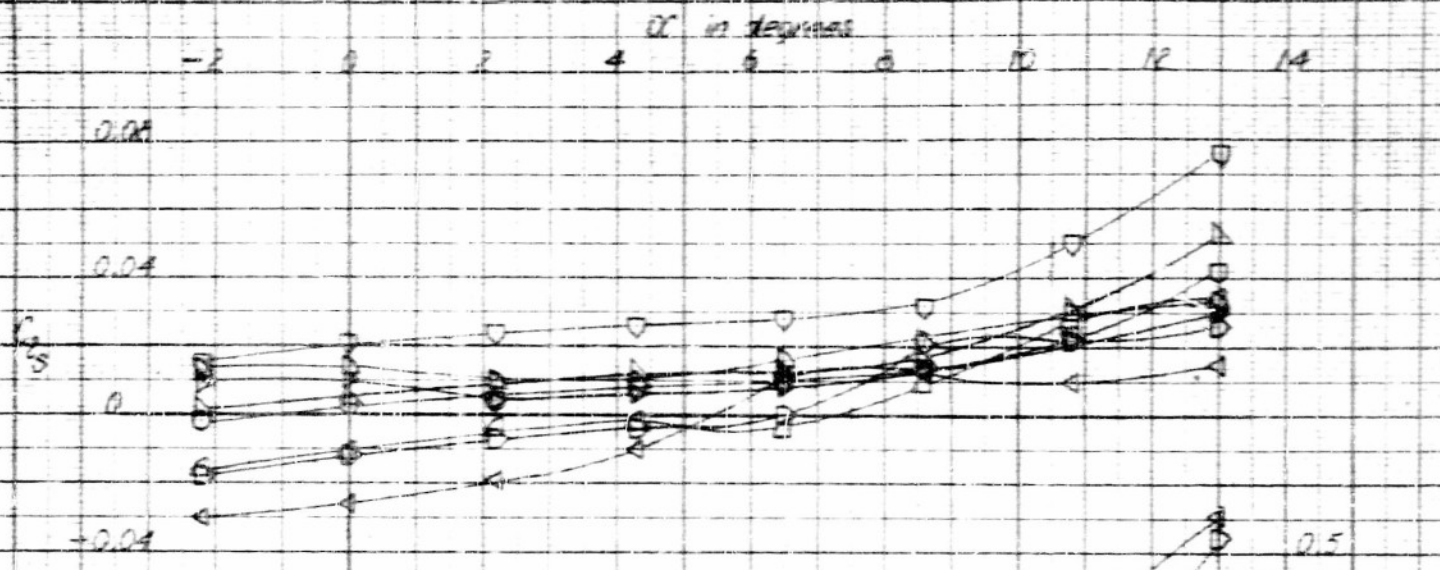
(a)  $Z = 9$  inches,  $L = 13.26$  inches,  $A_0 = 0^\circ$ ,  $W_0 = 2^\circ$ ,  $H = 0.1$  inches on

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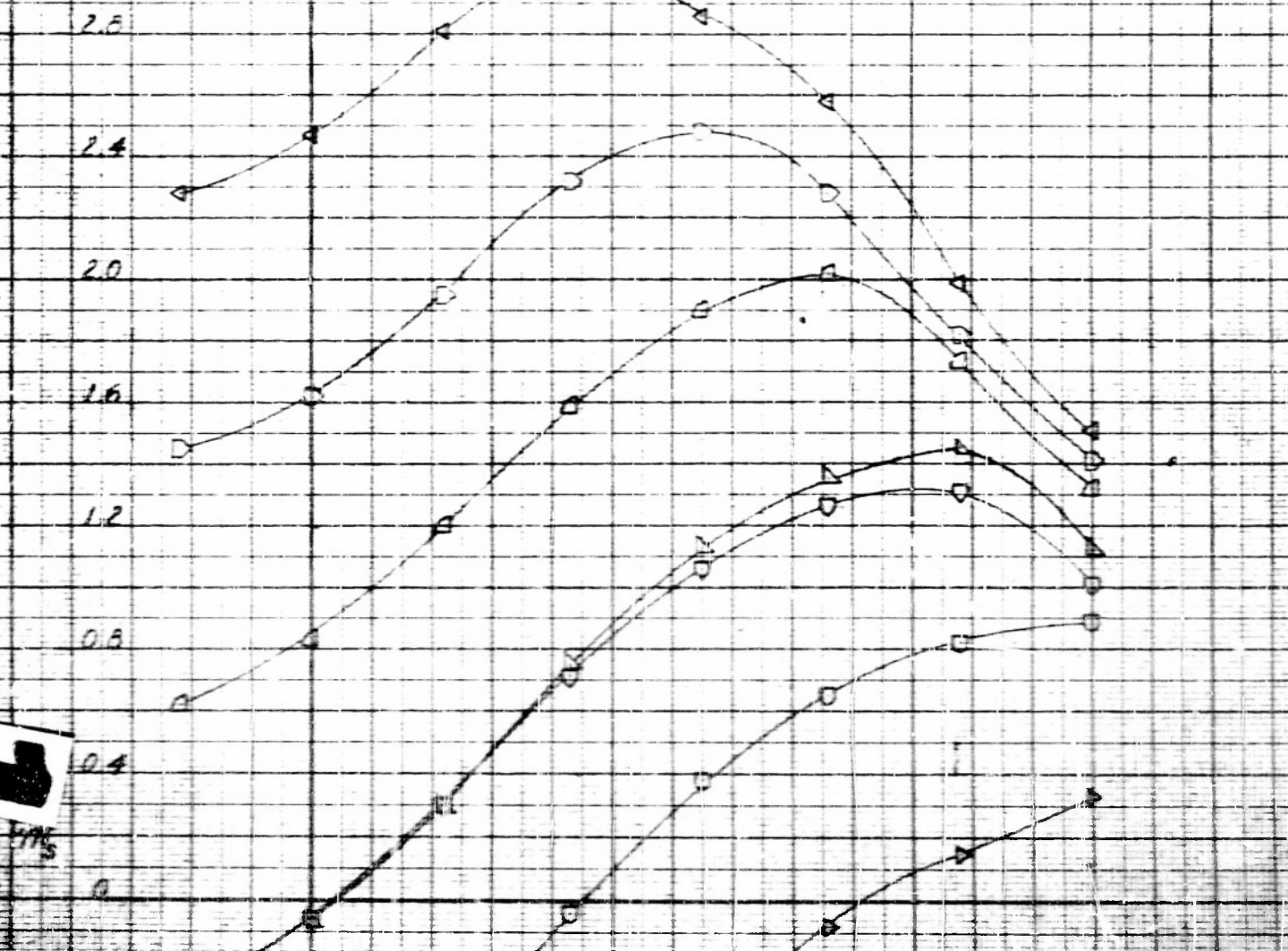
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	$\alpha_{H_1}$ in degrees	$\alpha_{H_2}$ in degrees	$\alpha_{H_3}$ in degrees	
▽	4	-4	0	-0.1
▽	12	12	12	-0.2
▽	3	3	3	
▽	4	4	4	
▽	0	0	0	
▽	-4	-4	-4	-0.3
▽	-3	-3	-3	
▽	-12	-12	-12	

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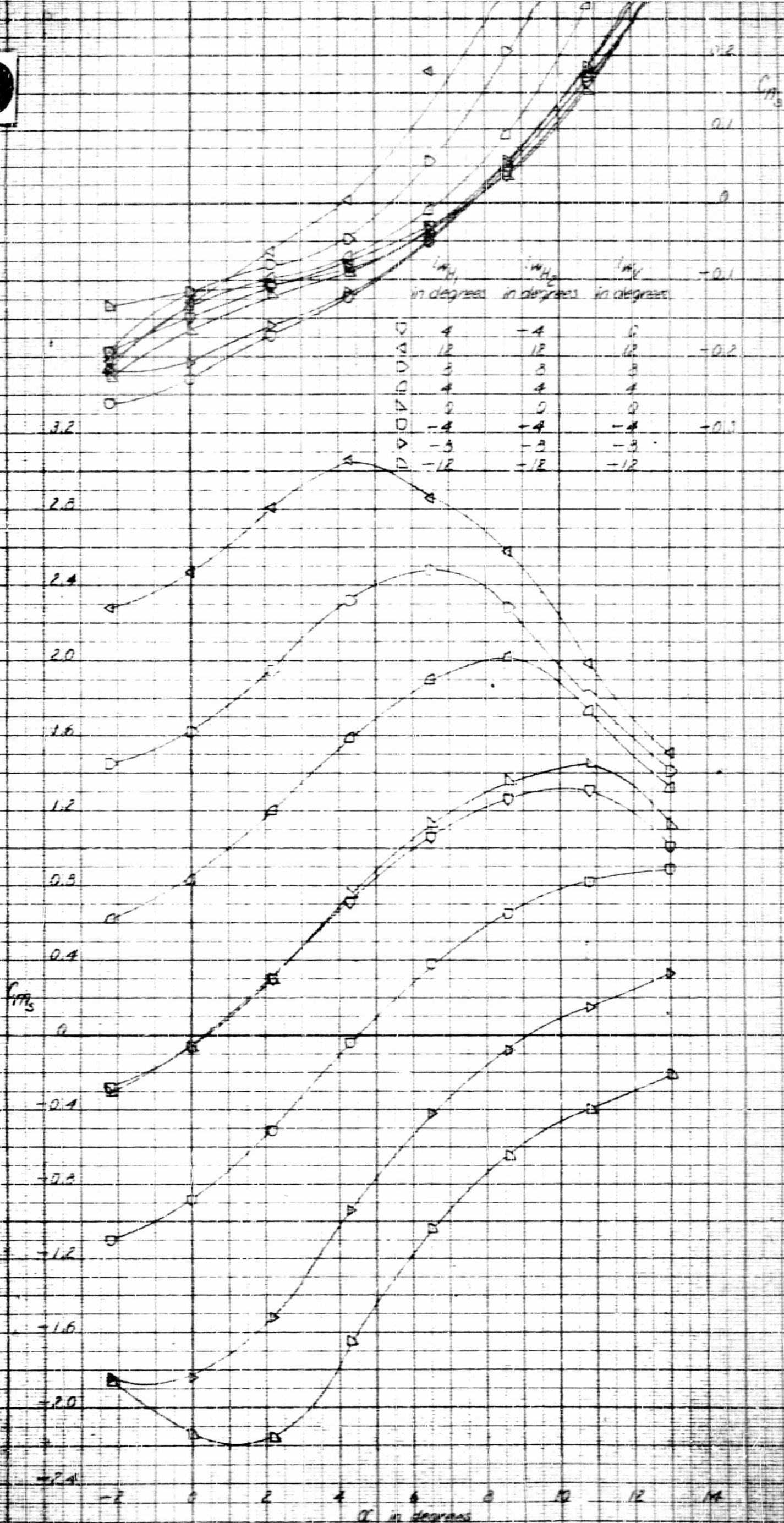


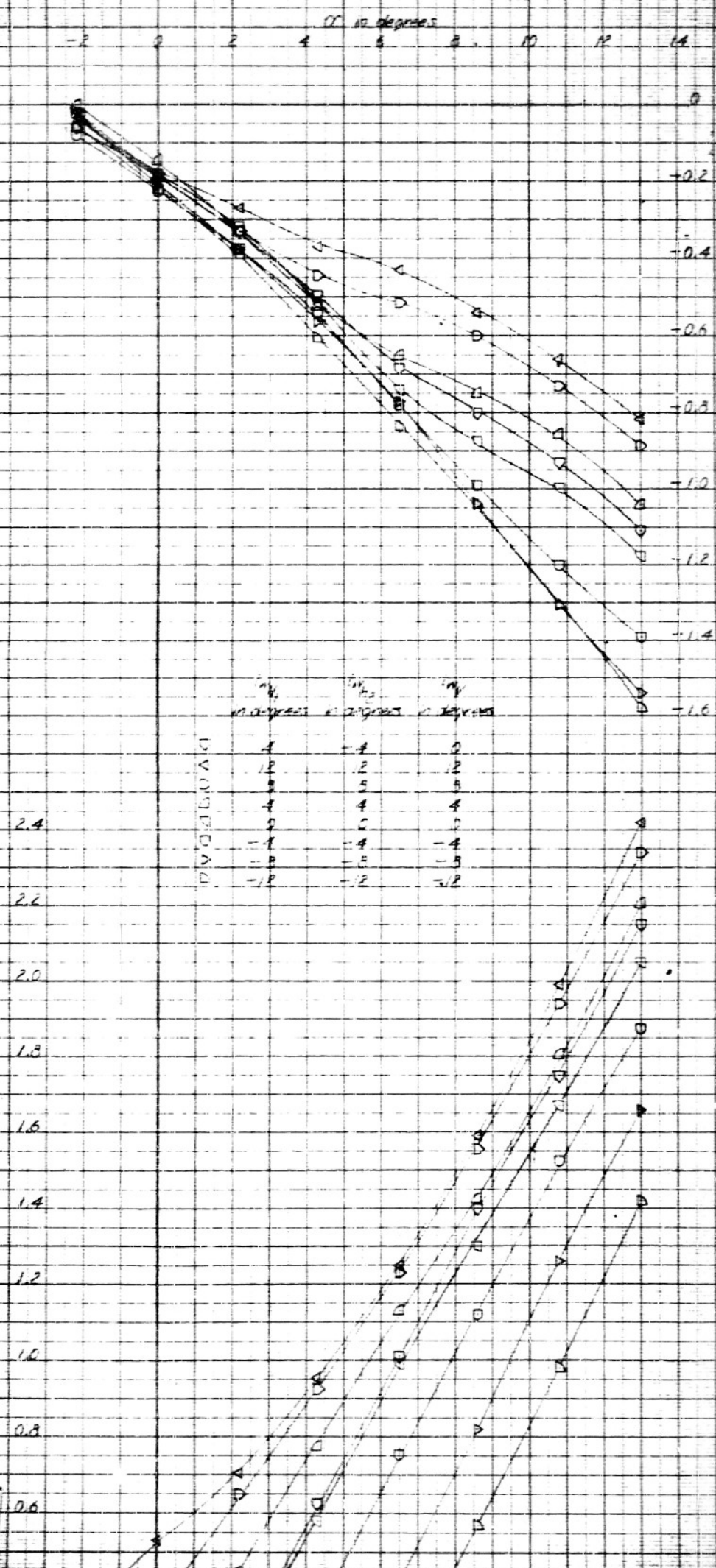
Figure 1.3 (Continued)

(d) (concluded)

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At 10 degrees

At 10 degrees



$\alpha$	$\beta$	$\gamma$
1.6	1.6	1.6
1.2	1.2	1.2
0.8	0.8	0.8
0.4	0.4	0.4
0	0	0
-0.4	-0.4	-0.4
-0.8	-0.8	-0.8
-1.2	-1.2	-1.2
-1.6	-1.6	-1.6

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1



2

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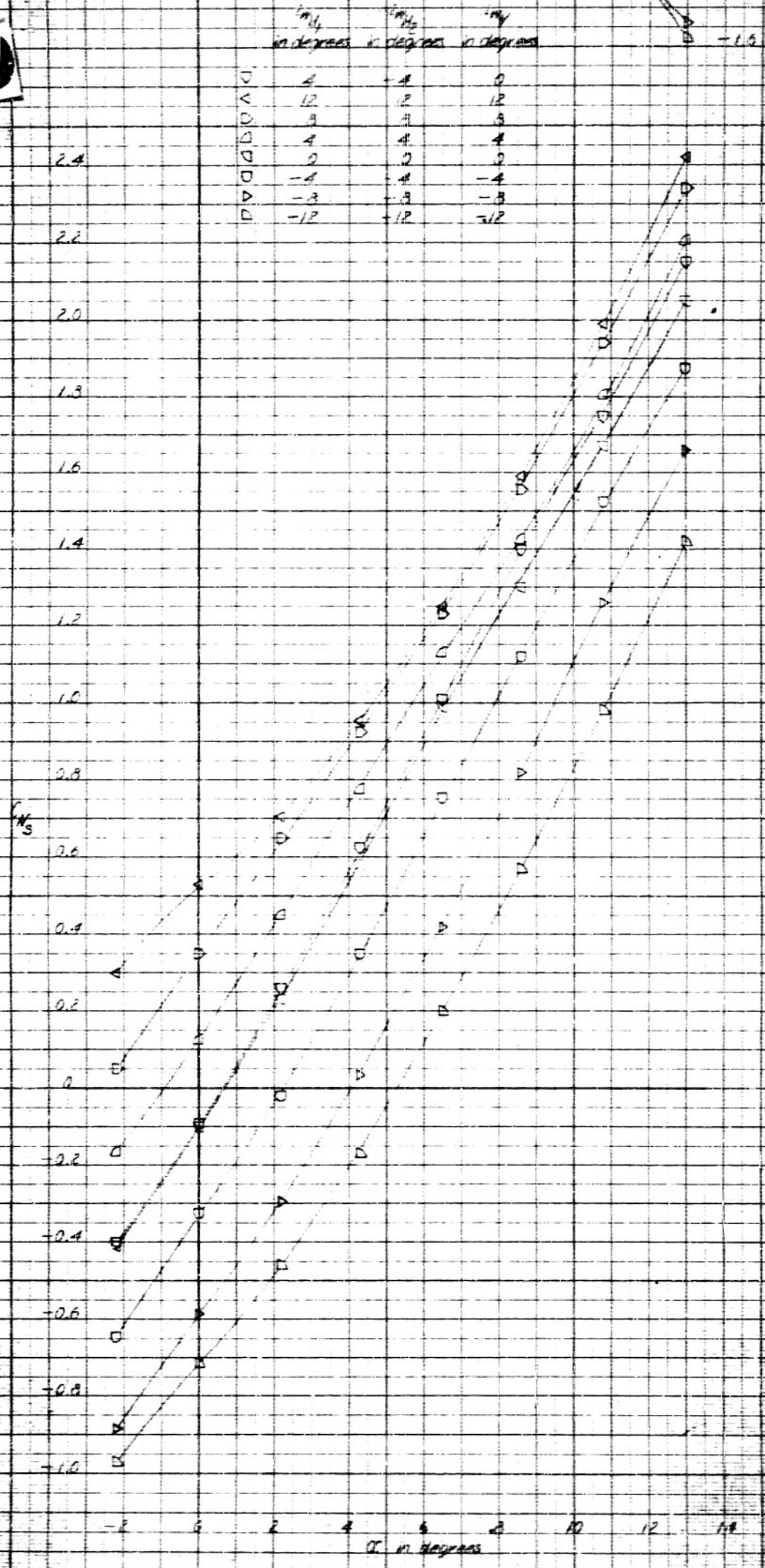


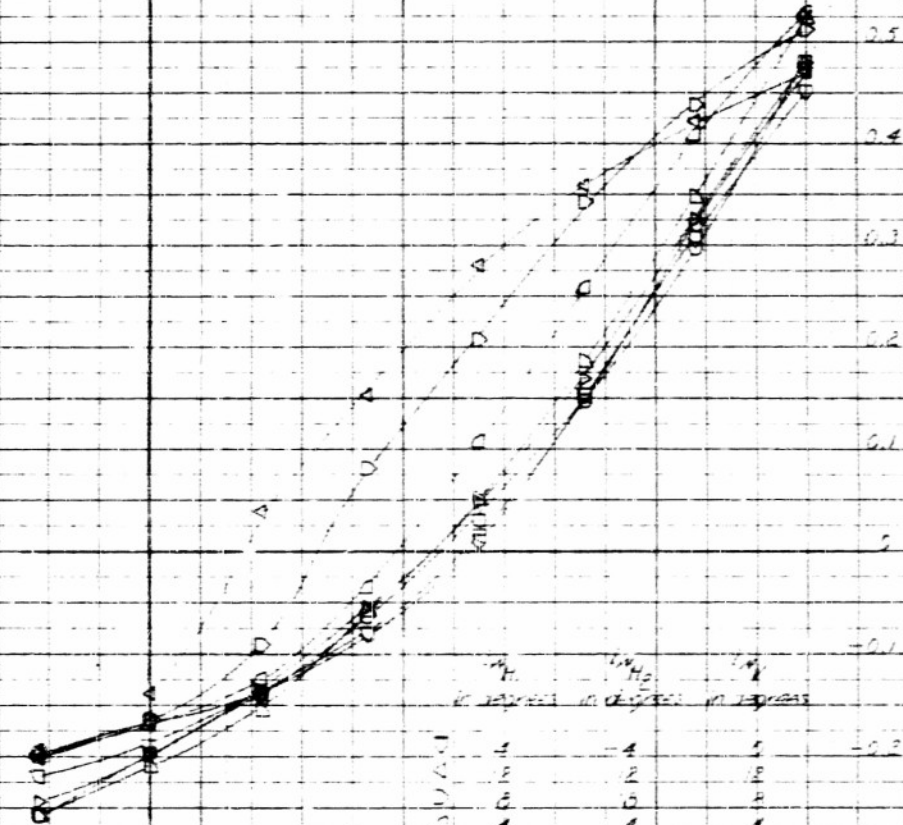
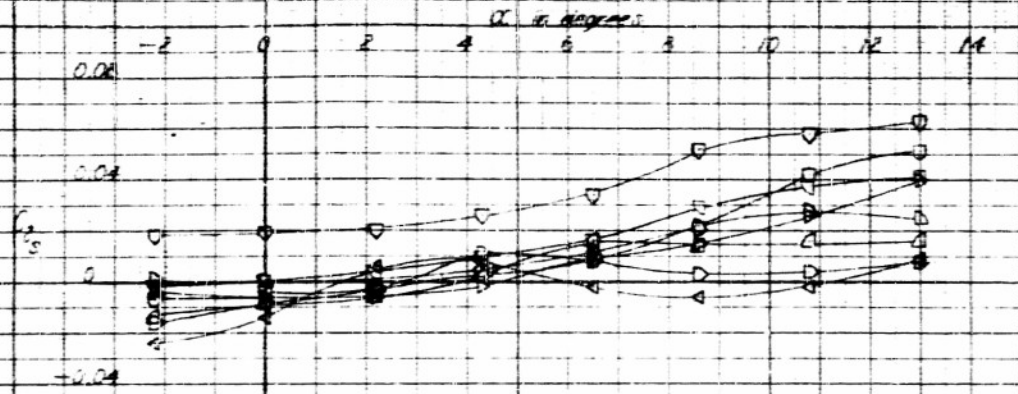
Figure 1.3 (Continued)

(e)  $Z = 0$  inch,  $Z = 13.25$  inches,  $\theta_0 = 6^\circ$ ,  $\theta_1 = 0^\circ$ ,  $\theta_2 = 0^\circ$ ,  $\theta_3 = 0^\circ$

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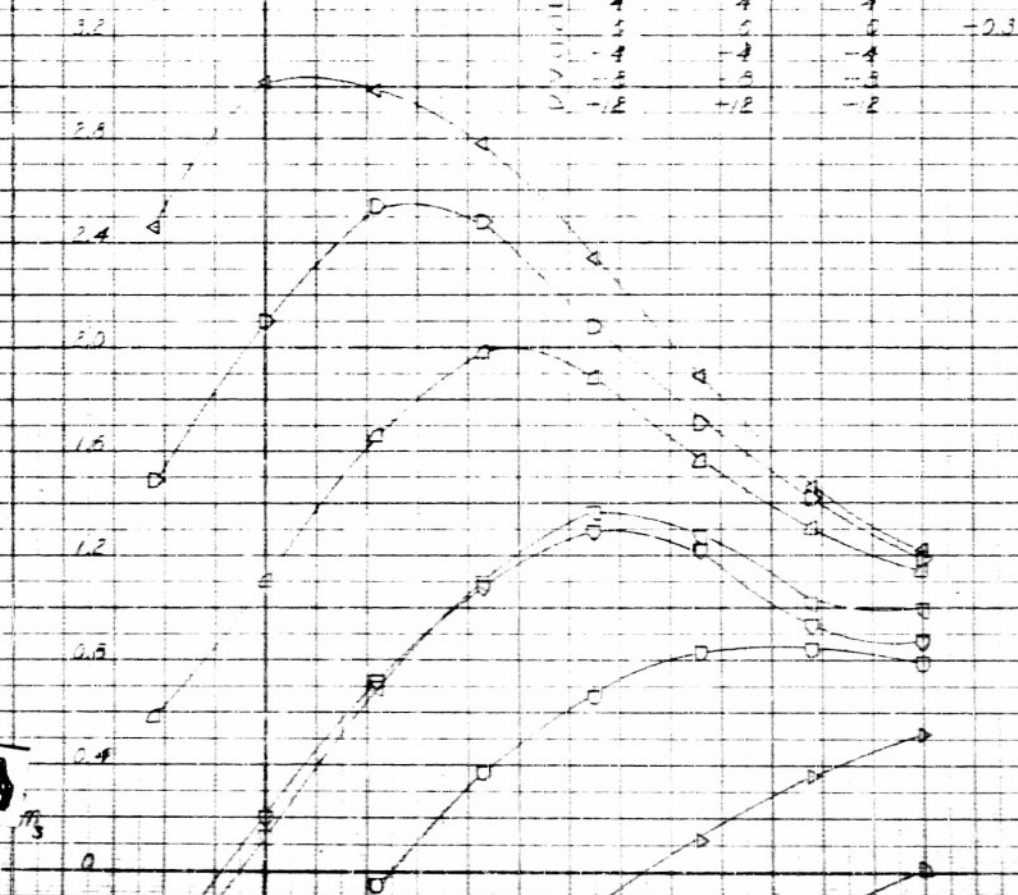
171000-55

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	$\alpha$ in degrees	$\alpha_{H_2}$ in degrees	$\alpha_1$ in degrees	
1	4	-4	5	-0.2
2	5	2	8	
3	6	0	8	
4	4	4	4	-0.3
5	5	5	6	
6	-4	-4	-4	
7	-5	-5	-5	
8	-6	+12	-2	

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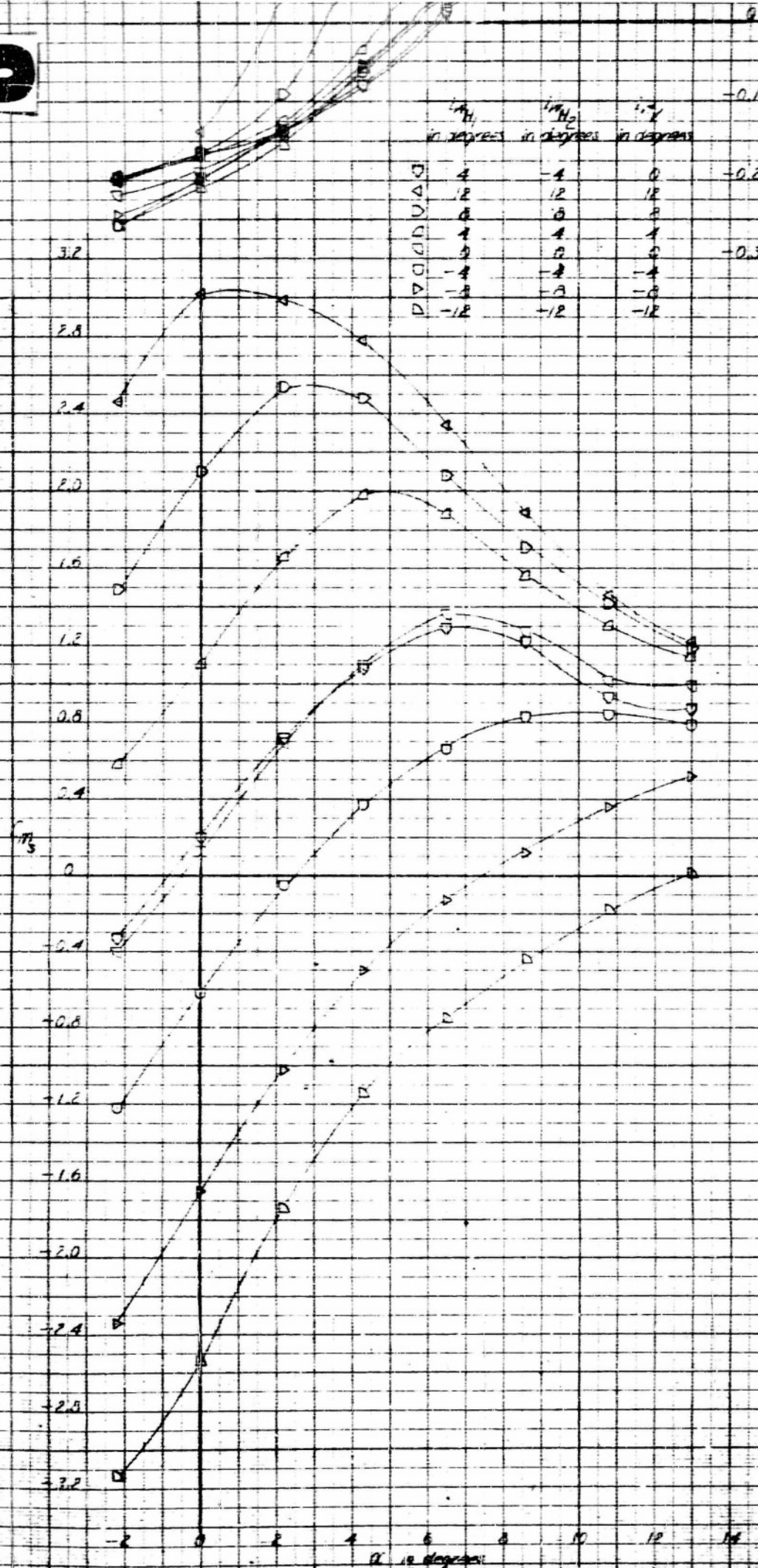


FIGURE 13 (Continued)

Figure 13 (Continued)  
(c) Continued

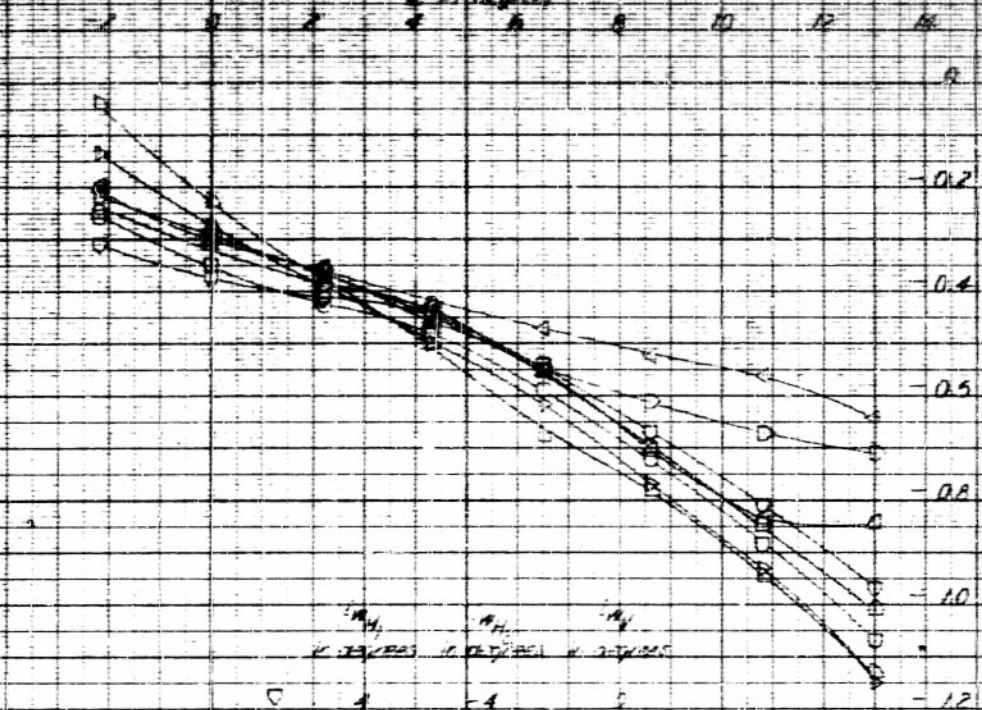
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11/1/60 '68

$\delta = 10$  degrees



2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

-0.4

-0.6

	$\alpha = 1$	$\alpha = 2$	$\alpha = 3$
1	1	2	3
2	2	4	6
3	3	6	9
4	4	8	12
5	5	10	15
6	6	12	18
7	7	14	21
8	8	16	24
9	9	18	27
10	10	20	30
11	11	22	33
12	12	24	36
13	13	26	39
14	14	28	42
15	15	30	45
16	16	32	48

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2

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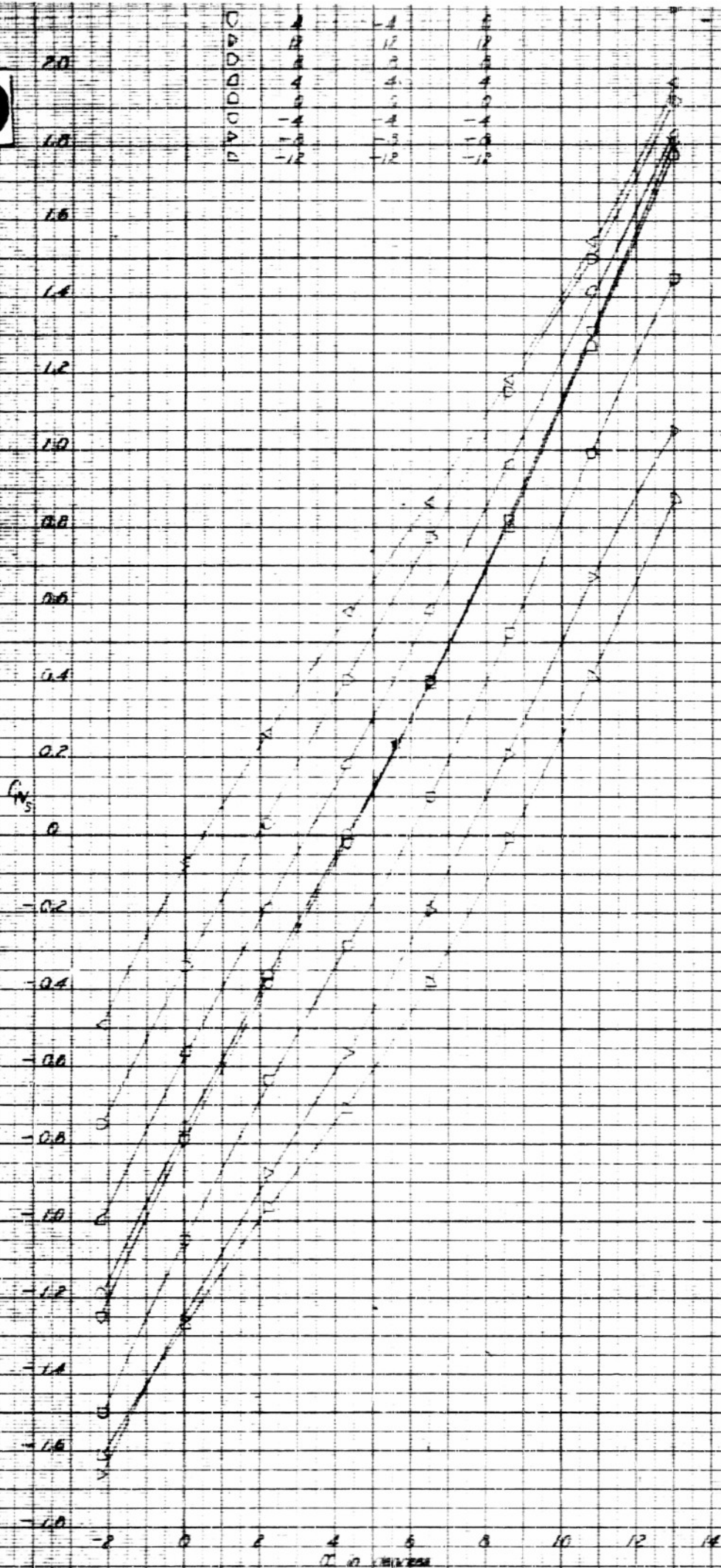


Figure 13.4 (continued)

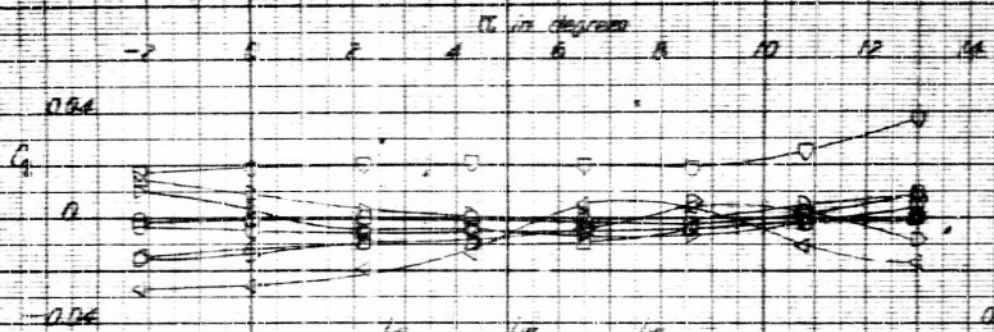
for  $X = 0$  inches,  $X = 13.36$  inches,  $S_0 = 0^\circ$ ,  $W_0 = 0^\circ$ ,  $W = 0^\circ$ , Ayden, Oz

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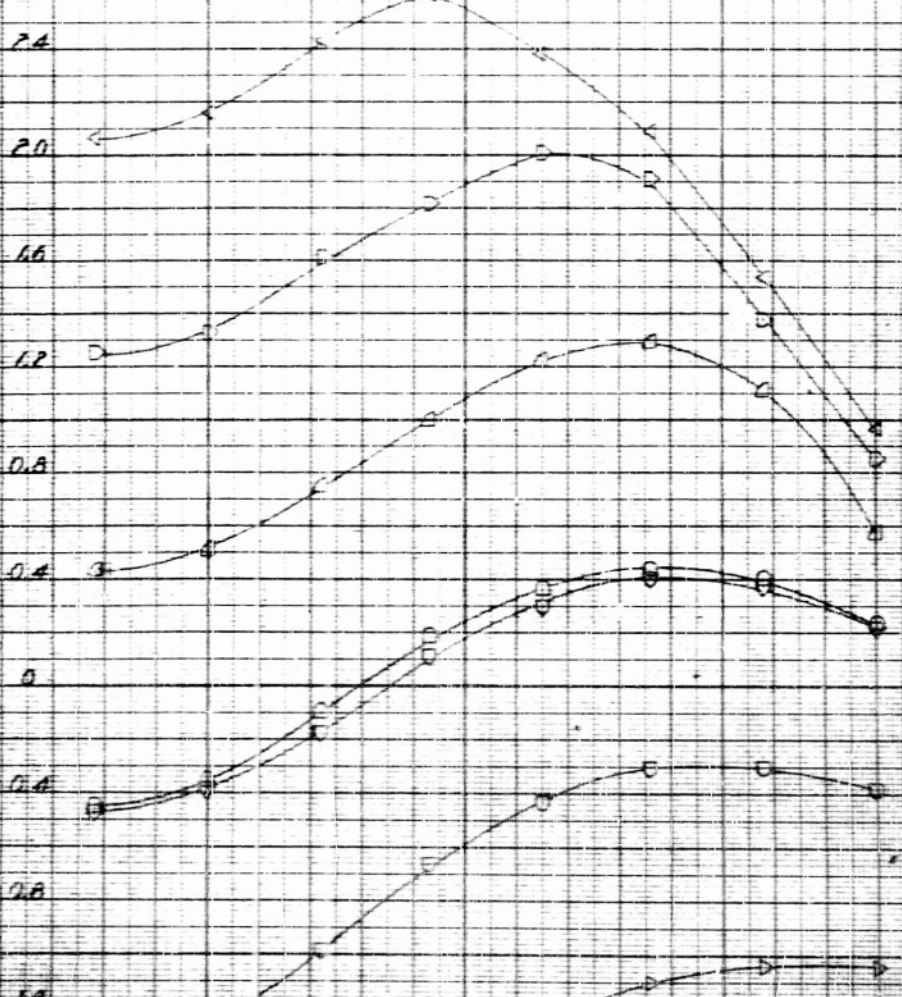
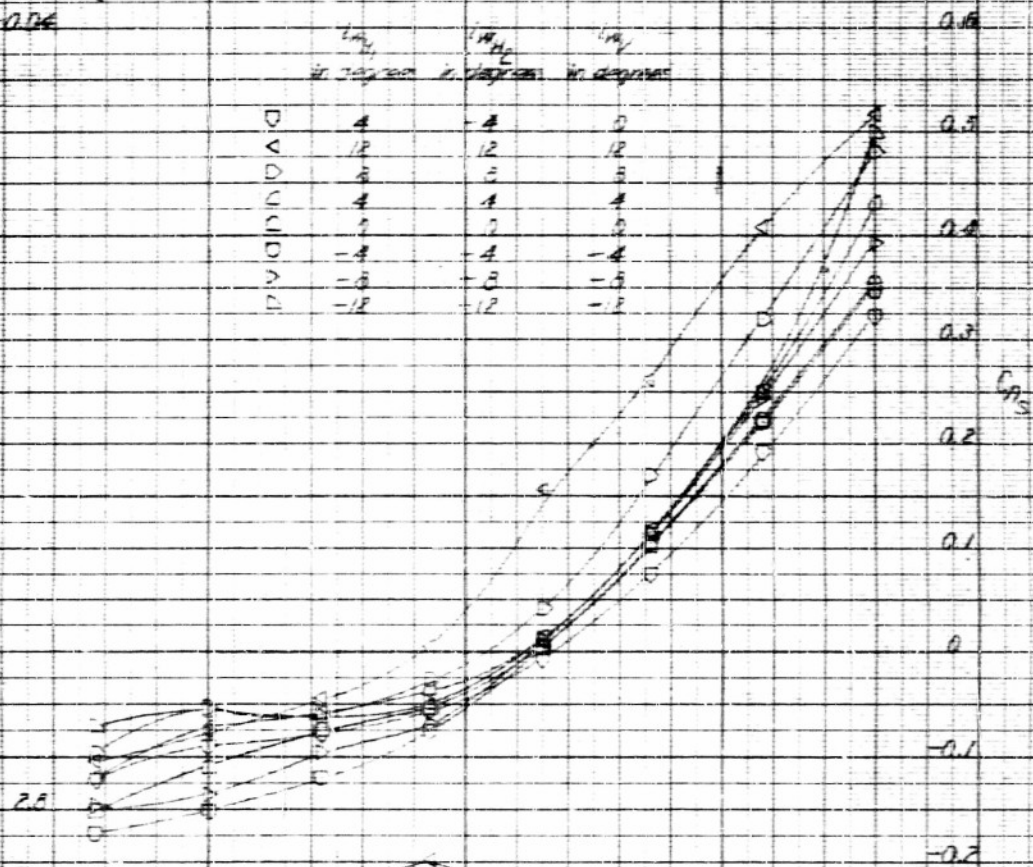


TEST NO. 100-10

ALPHA 0.64



	$\alpha_{H_1}$ in degrees	$\alpha_{H_2}$ in degrees	$\alpha_{H_3}$ in degrees
D	4	-4	0
V	12	12	12
Δ	8	8	8
□	4	4	4
○	0	0	0
▽	-4	-4	-4
◇	-8	-8	-8
×	-12	-12	-12



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2

00 -4 -4 -4  
 00 -6 -6 -6  
 00 -12 -12 -12

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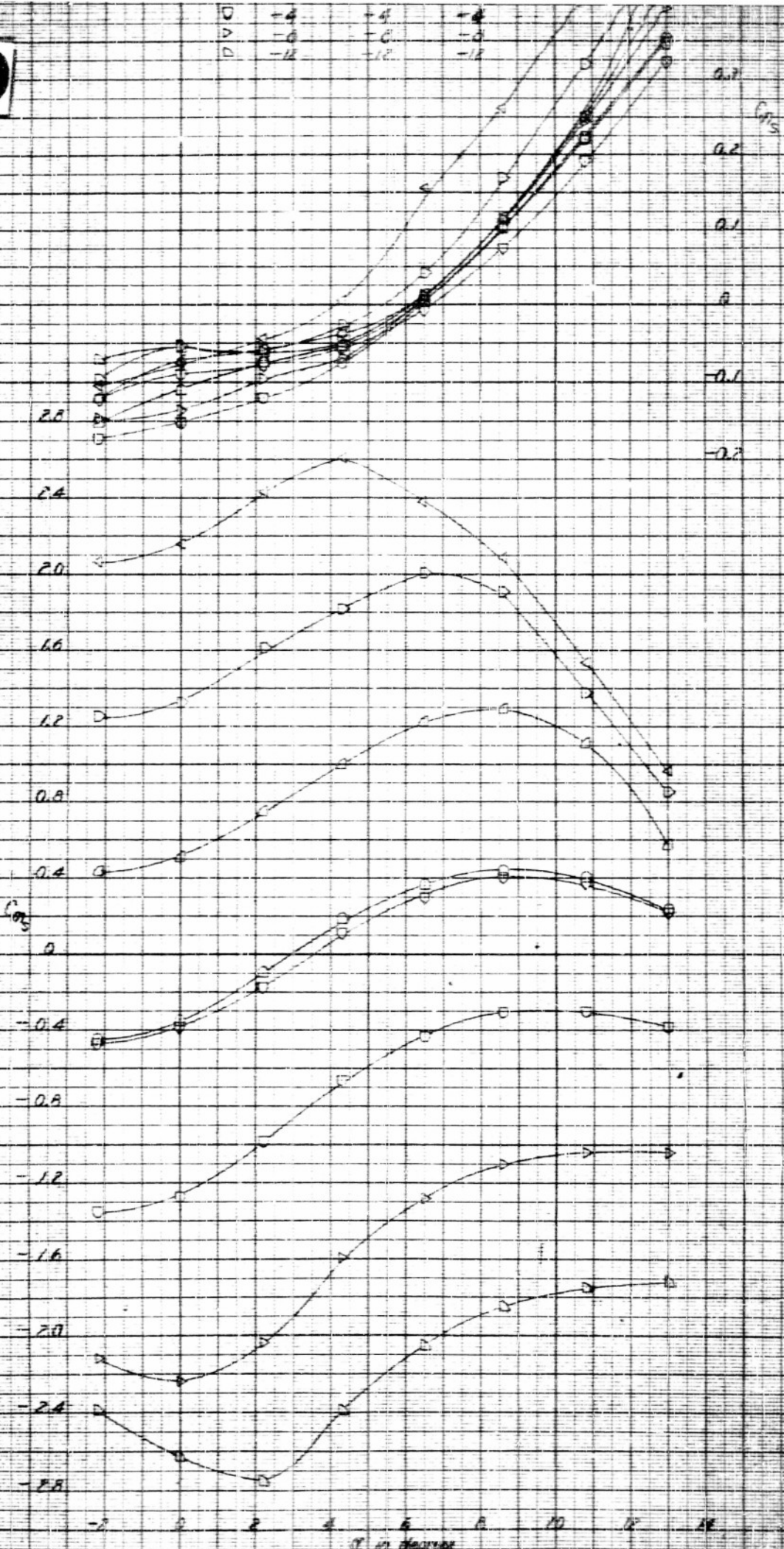
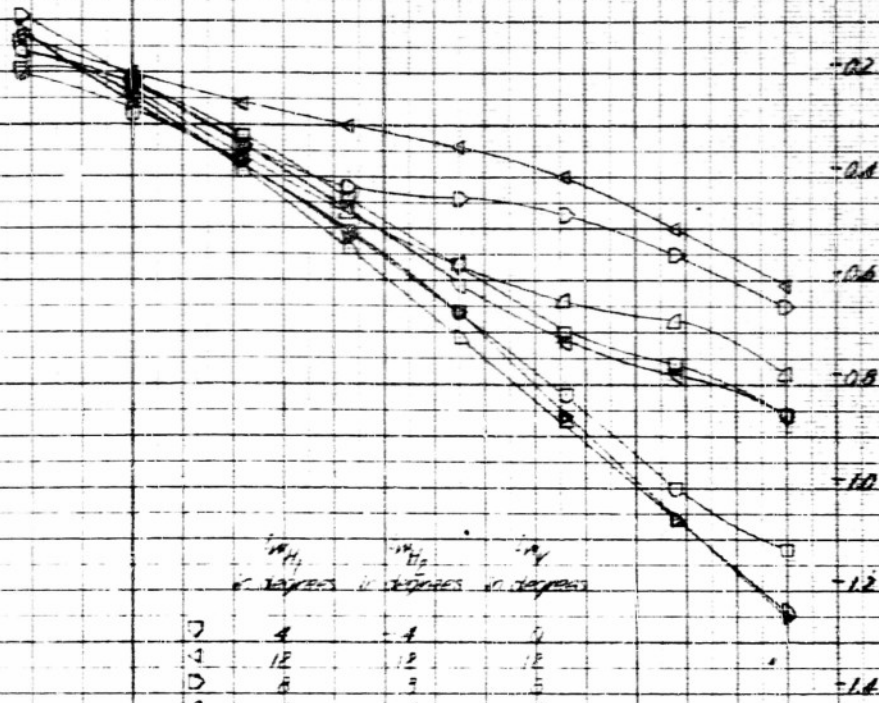


Figure 13 (Continued)  
 (b) Concluded

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-2 0 2 4 6 8 10 12 14



	$H_1$	$H_2$	$H_3$
	4	4	4
	12	12	12
	8	8	8
	4	4	4
	0	0	0
	-4	-4	-4
	-8	-8	-8
	-12	-12	-12

28

26

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18

16

14

12

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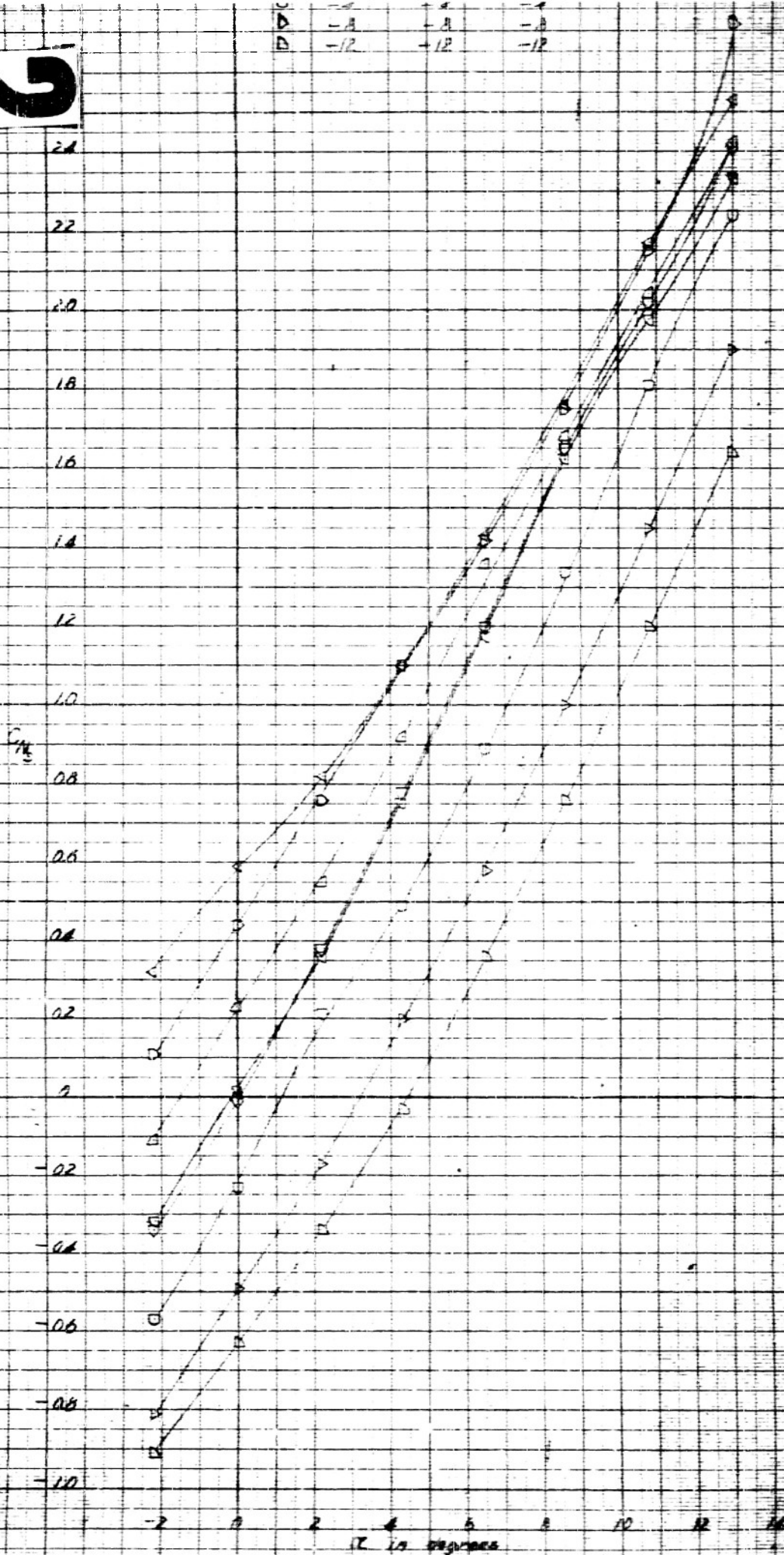


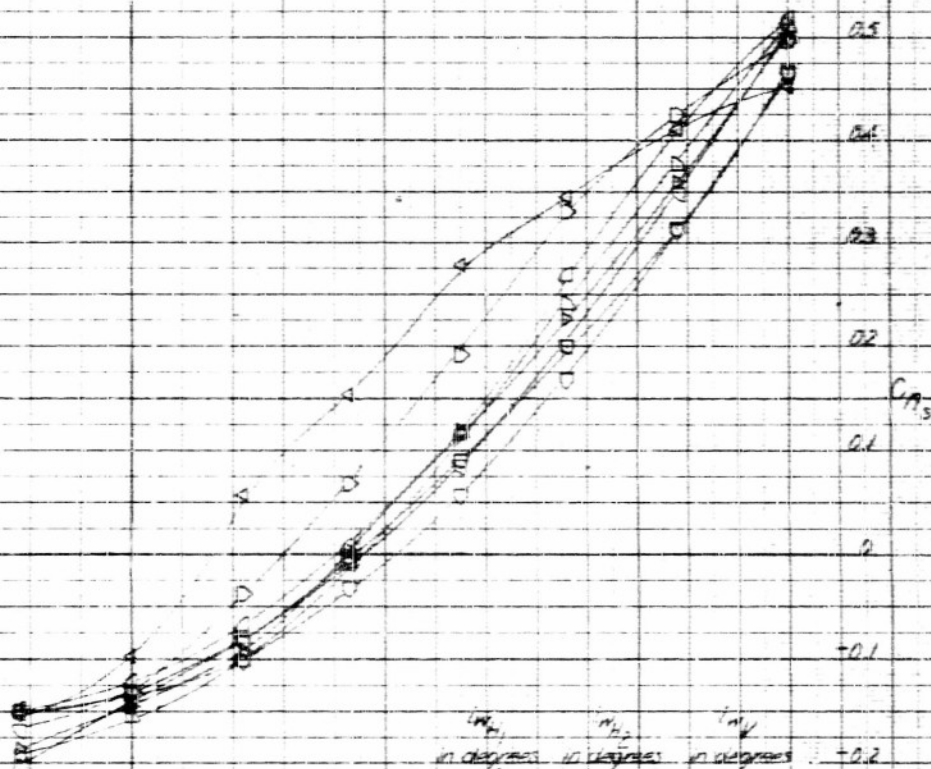
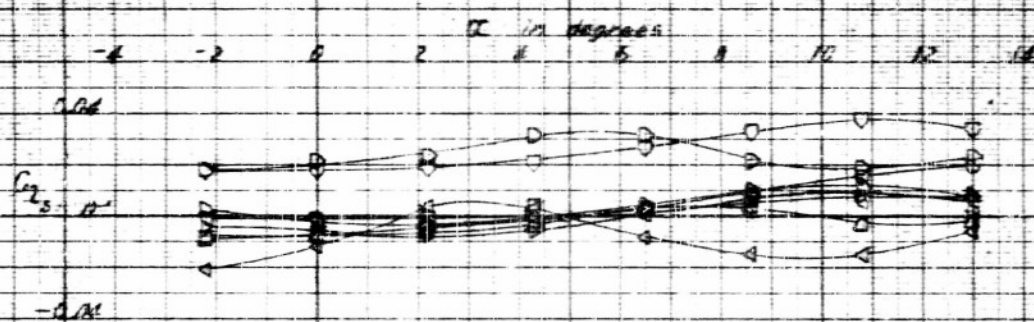
Figure 13 (continued)

(b)  $Z = 0$  inch,  $R = 45$  inches,  $\theta_0 = 0^\circ$ ,  $\theta_0 = 0^\circ$ ,  $\theta = 0^\circ$ ,  $\theta = 0^\circ$

FIGURE 13



BY 10144-53



	$\alpha_{H1}$ in degrees	$\alpha_{H2}$ in degrees	$\alpha_{H3}$ in degrees
U	4	-4	0
V	2	12	12
O	5	5	5
D	4	4	4
V	5	5	5
D	-4	-4	-4
V	-2	-2	-2
D	-12	-12	-12

32

28

24

20

16

12

0.8

0.4

0

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$C_{m5}$

2

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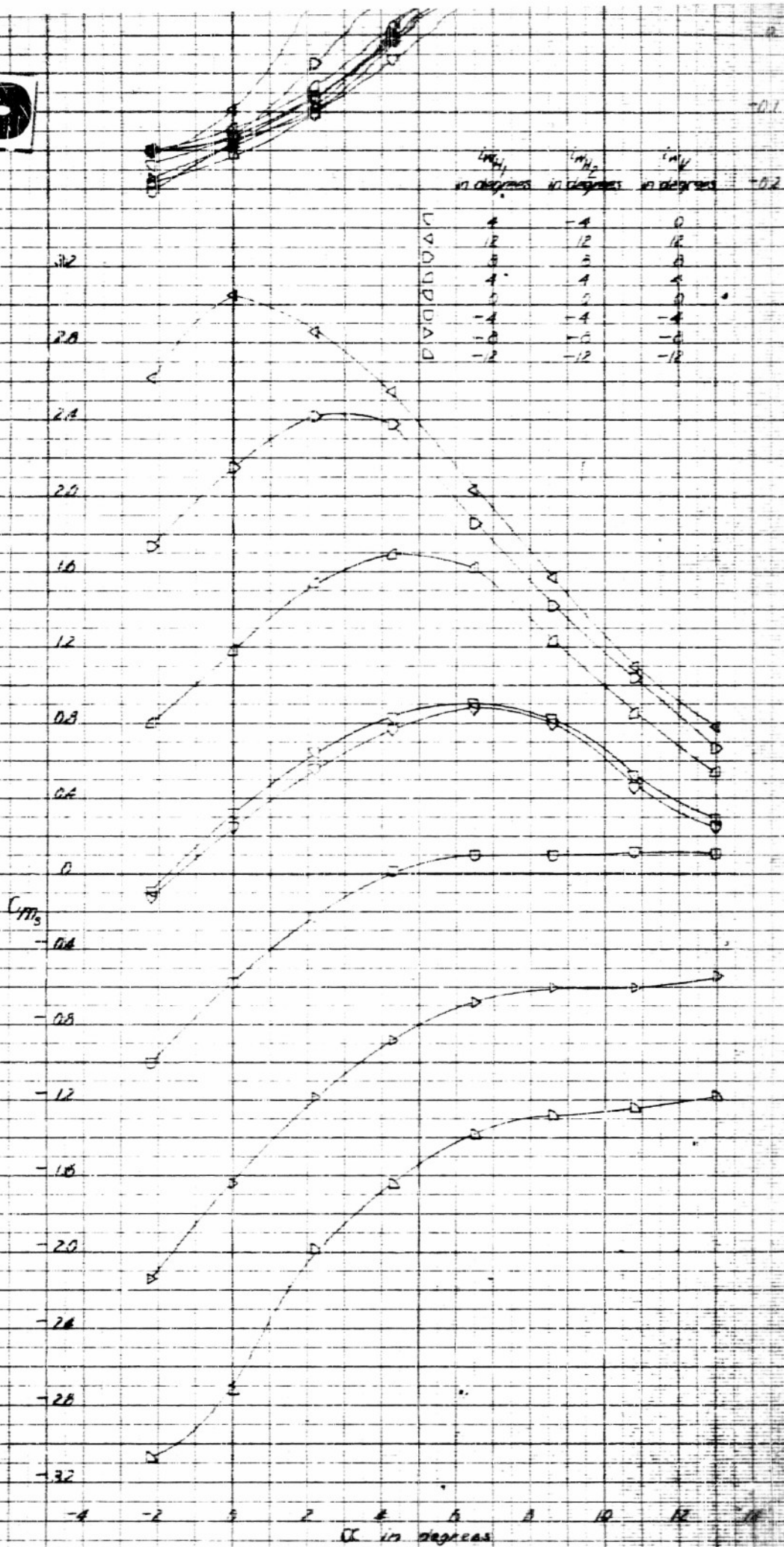


FIGURE 13 (Continued)

Figure 13 (Continued)

6) Continued

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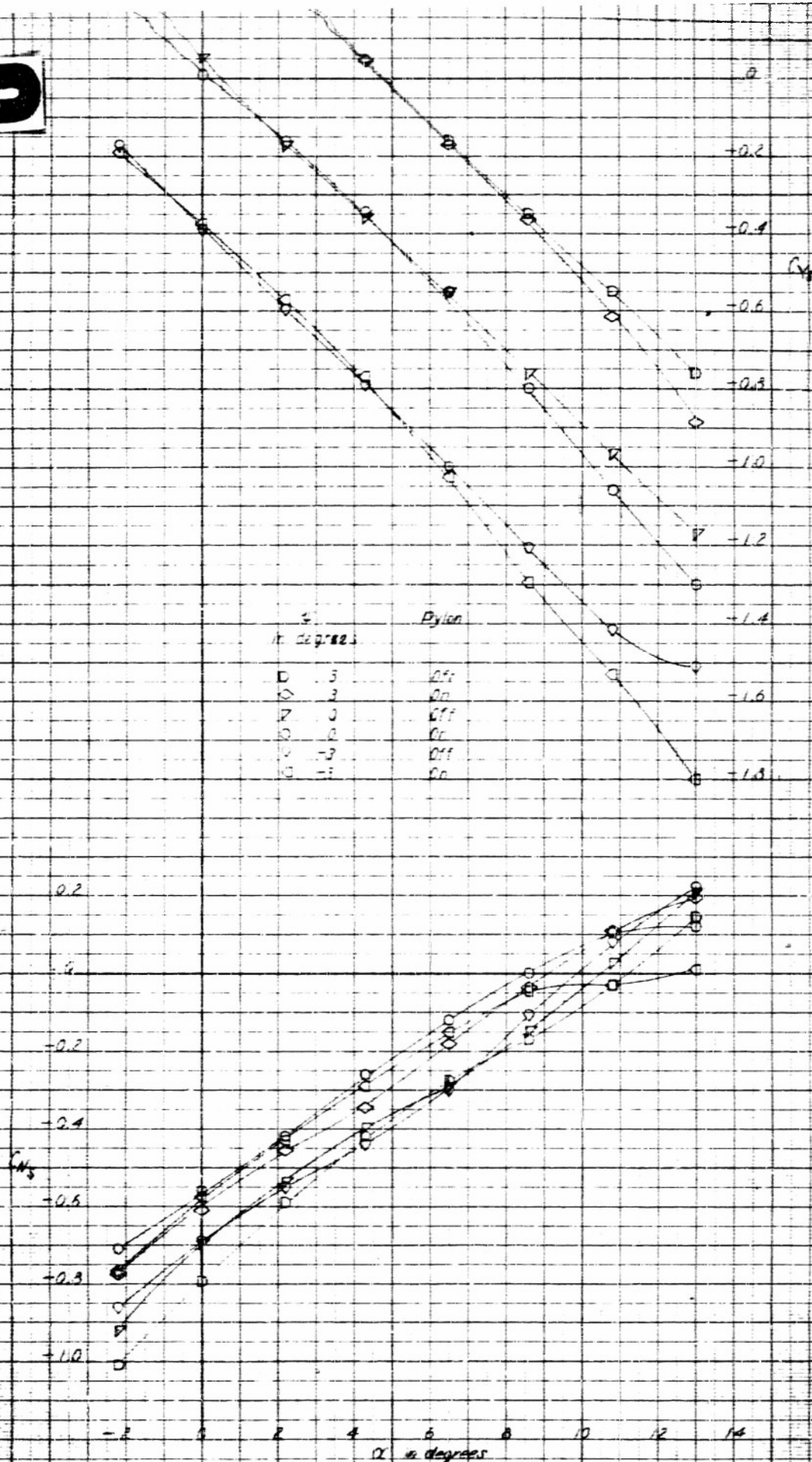


Figure 14—Effect of the Pylon and Airplane Yaw Upon the Aerodynamic Characteristics of a 0.17-Scale Model XAAM-N-4 Guided Missile in the Proximity of a 0.179-Scale Model F4U-1 Airplane at the Inboard Station

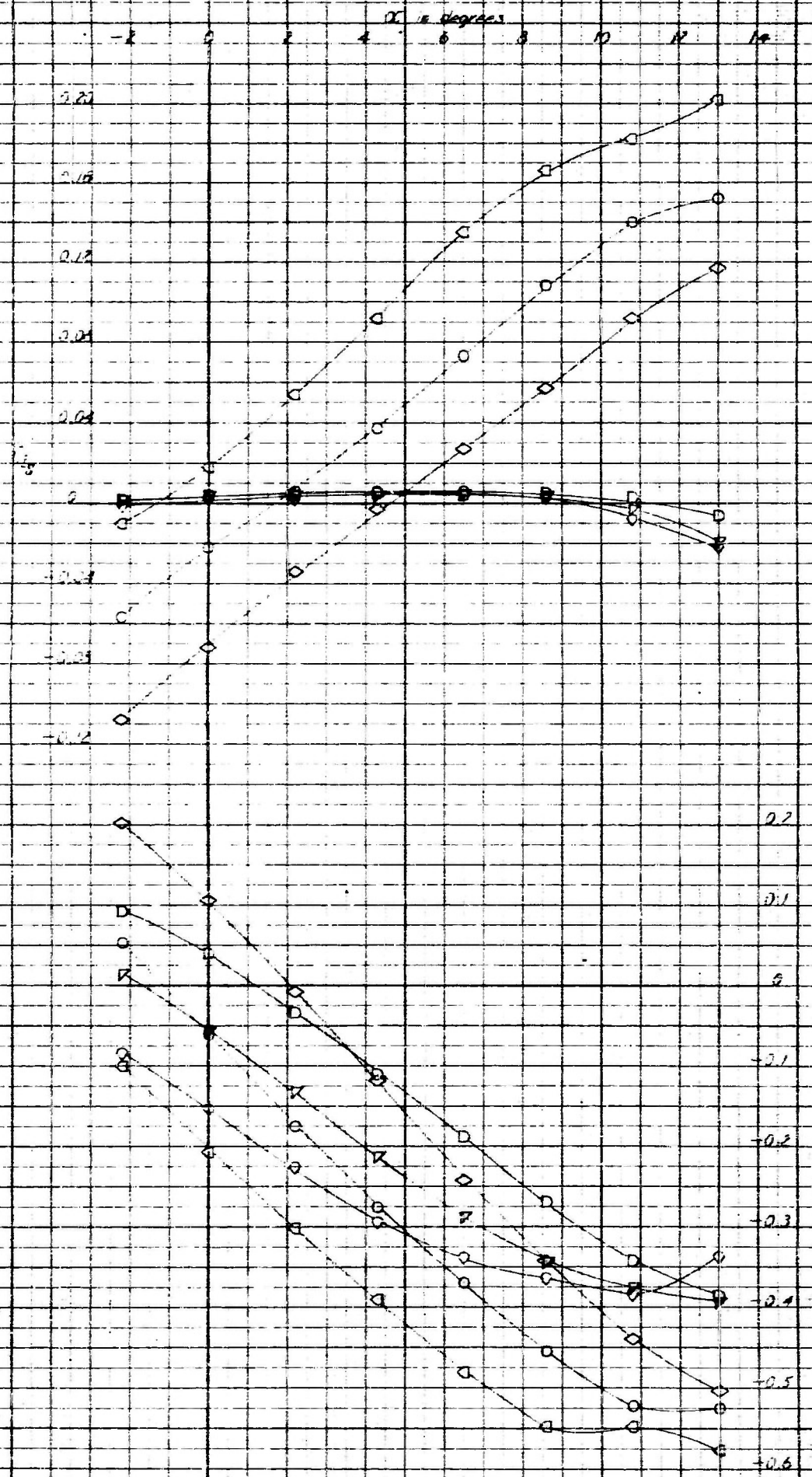
(a)  $\beta = 0^\circ$ ,  $\gamma = 0^\circ$ ,  $\delta = 0^\circ$ ,  $\epsilon = 0^\circ$

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$\theta$	$\theta$ in degrees	Exp.
D	3	Off
$\diamond$	3	On
$\nabla$	0	Off
O	0	On

2

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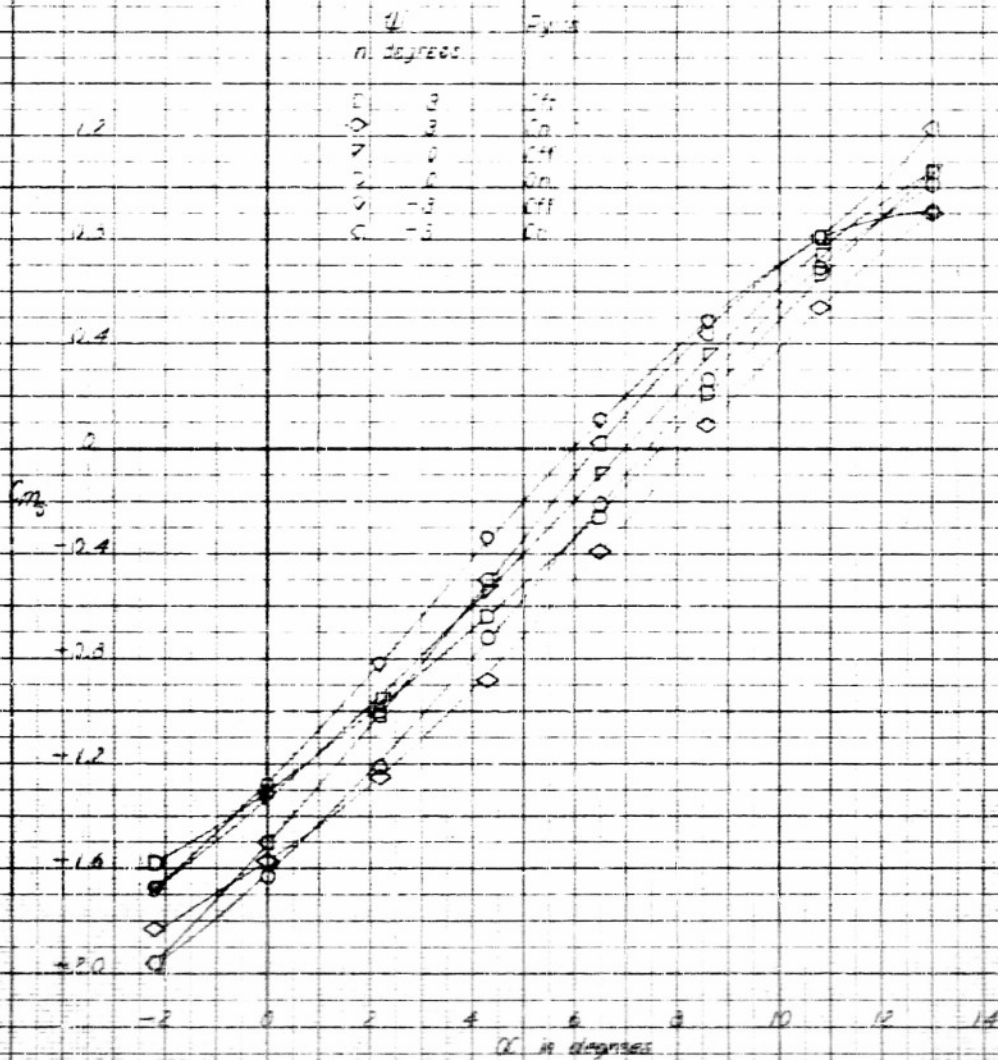


Figure 14 (continued)

(a) Continued

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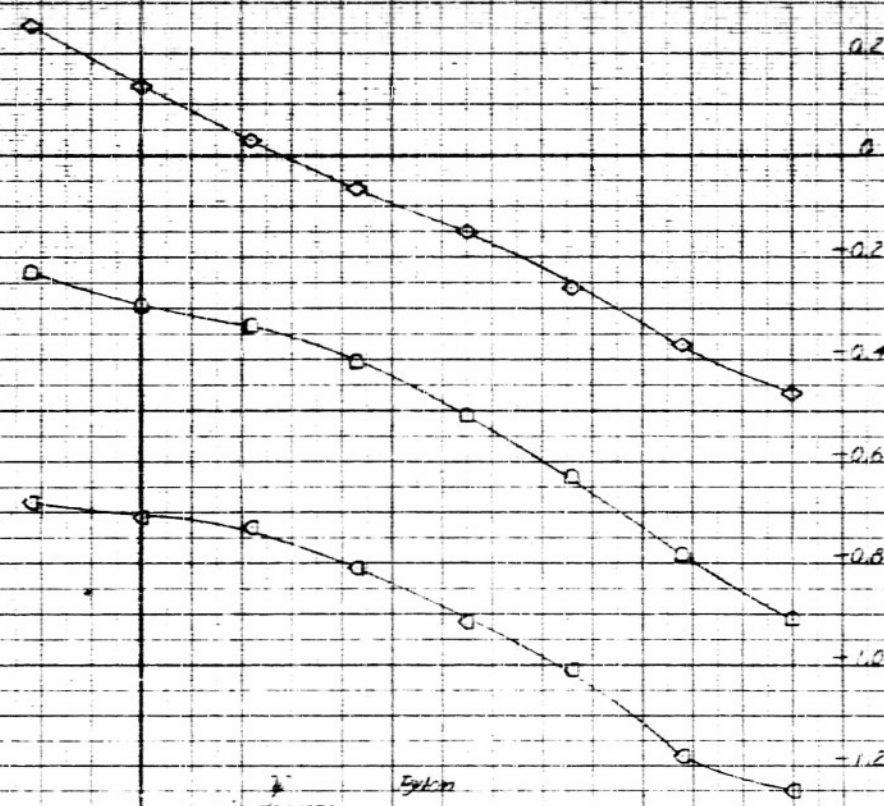


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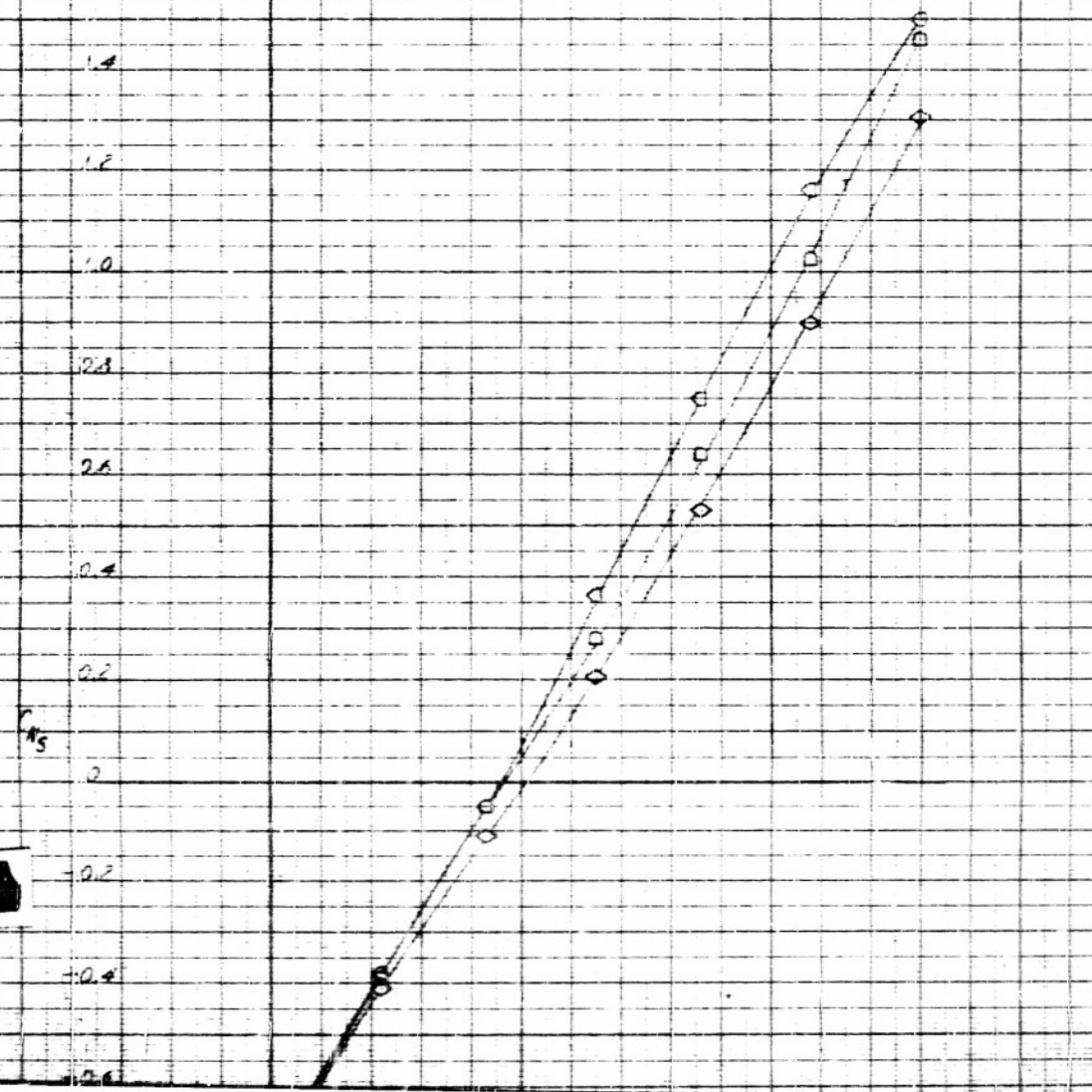
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$\delta$  in degrees



$\delta$	in degrees	Explan
$\diamond$	3	En
$\square$	2	En
$\triangle$	-3	En



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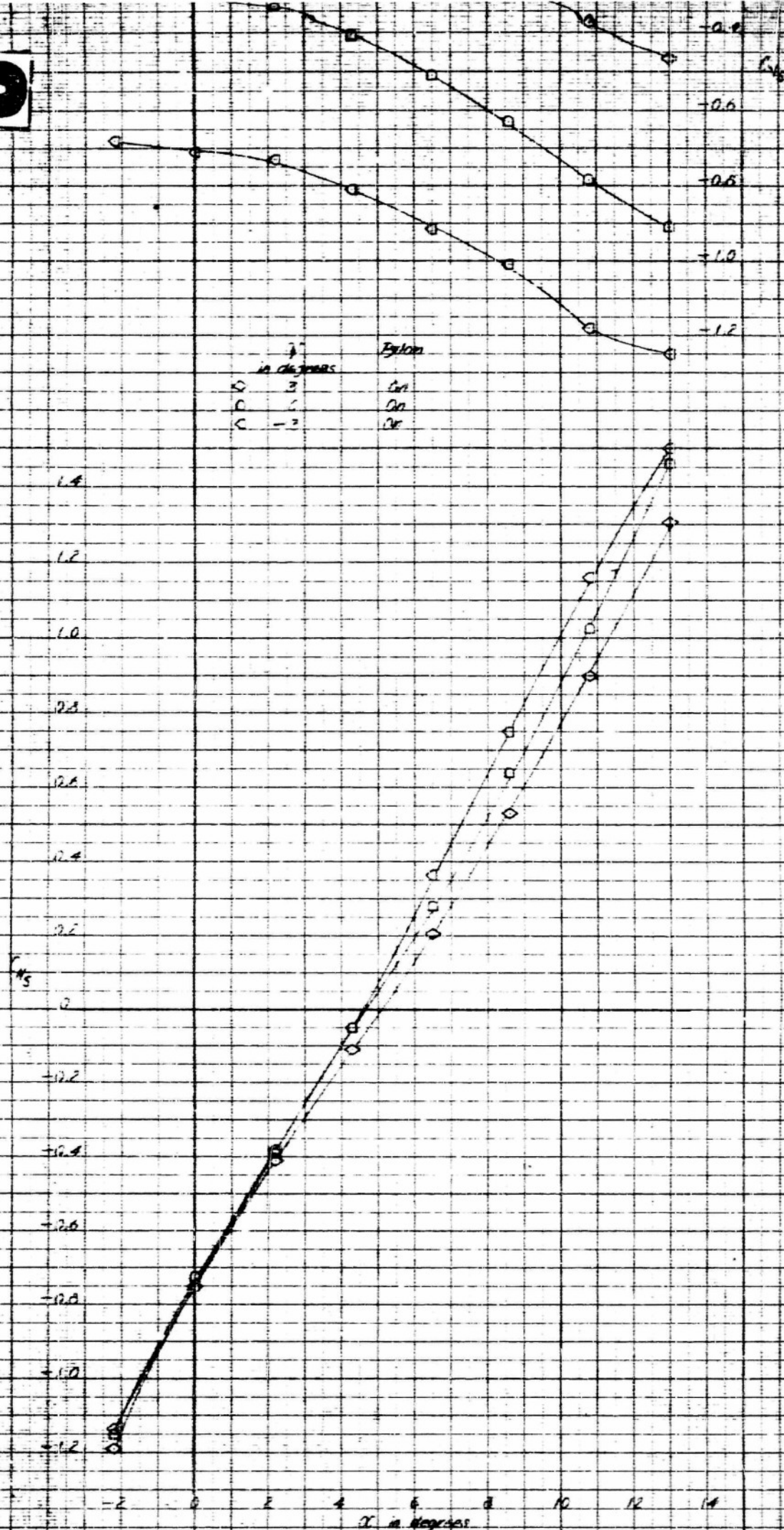


Figure 14 (Continued)

(N)  $r = 2.04$  inches,  $x = 18.35$  inches,  $\theta_1 = 0^\circ$ ,  $\theta_2 = 0^\circ$

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FIGURE 14 (Continued)

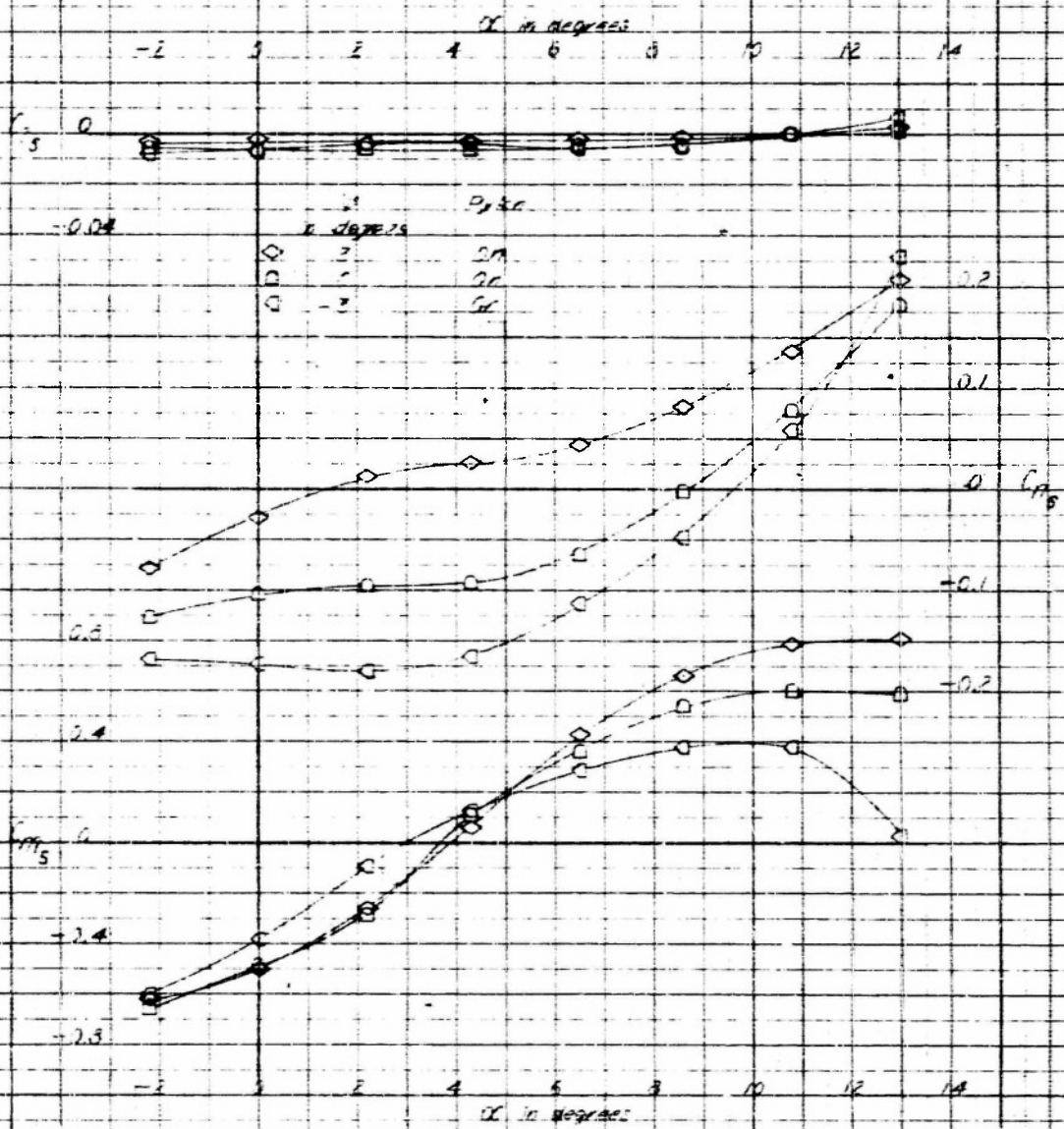


Figure 14 (Continued)  
(to be continued)

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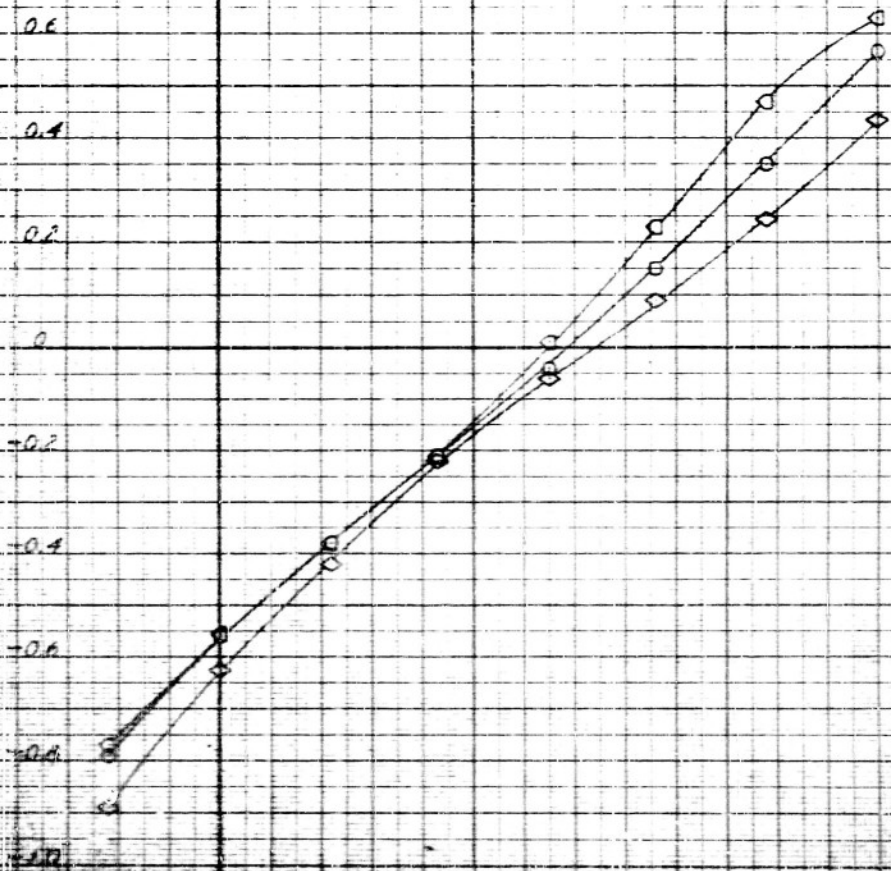
$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0.6  
0.4  
0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2  
-1.4

$\psi$ in degrees	$P_{\text{type}}$
$\diamond$	$Q_n$
$\circ$	$Q_n$
$\triangle$	$Q_n$

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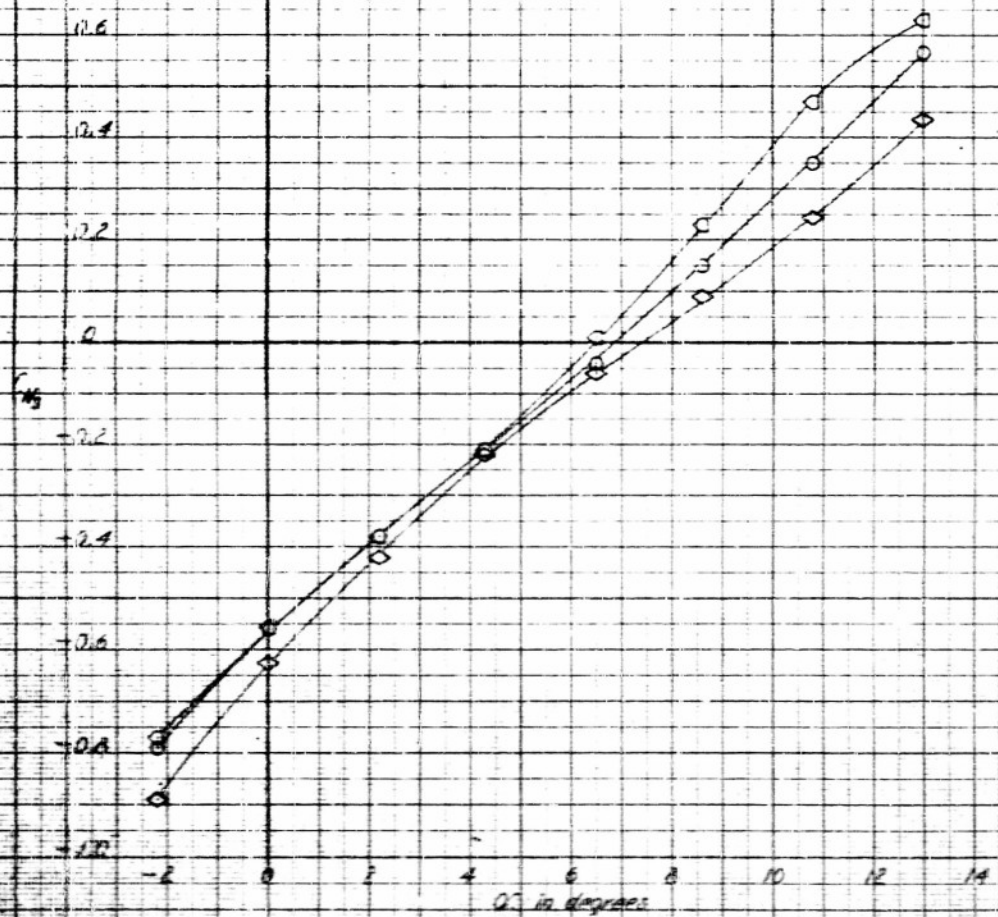
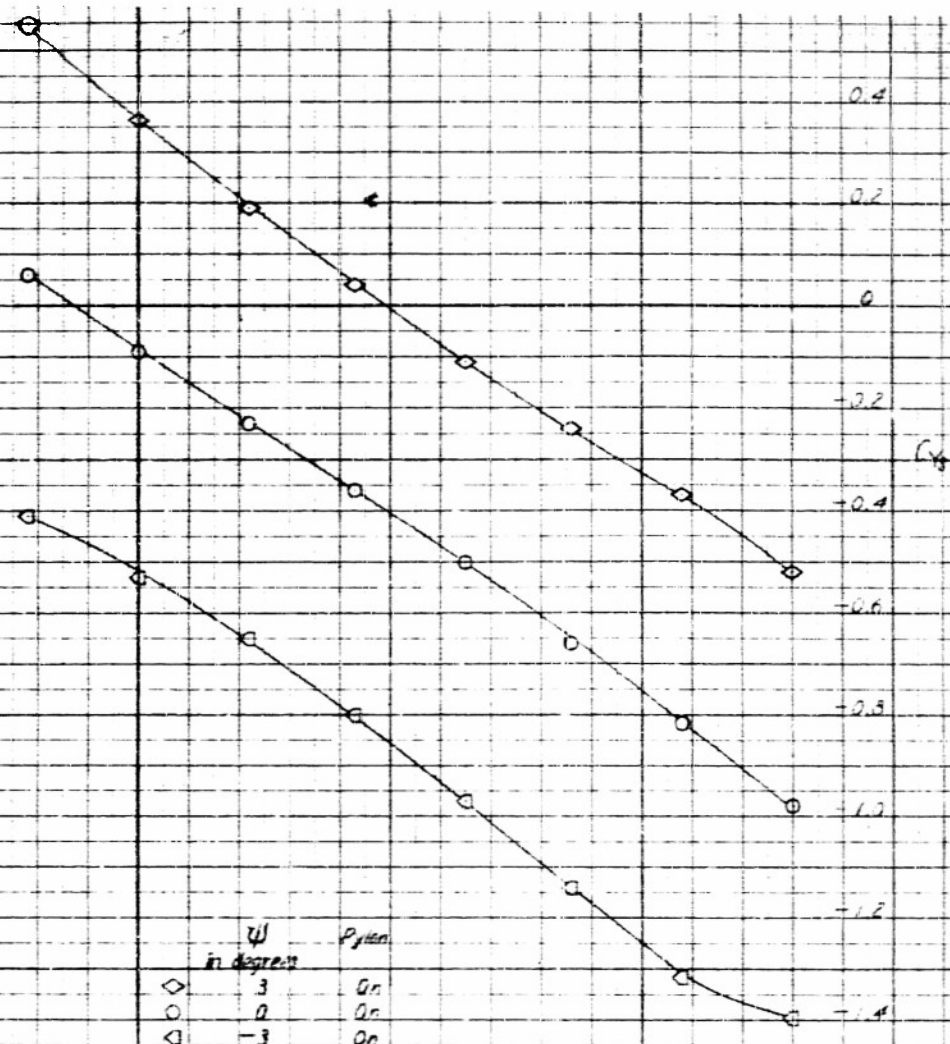


Figure 14 (Continued)

$\rho = 0.0012$ ,  $\mu = 0.0001$ ,  $c_d = 0.0$ ,  $\psi = 0^\circ$

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FIGURE 14 (Continued)

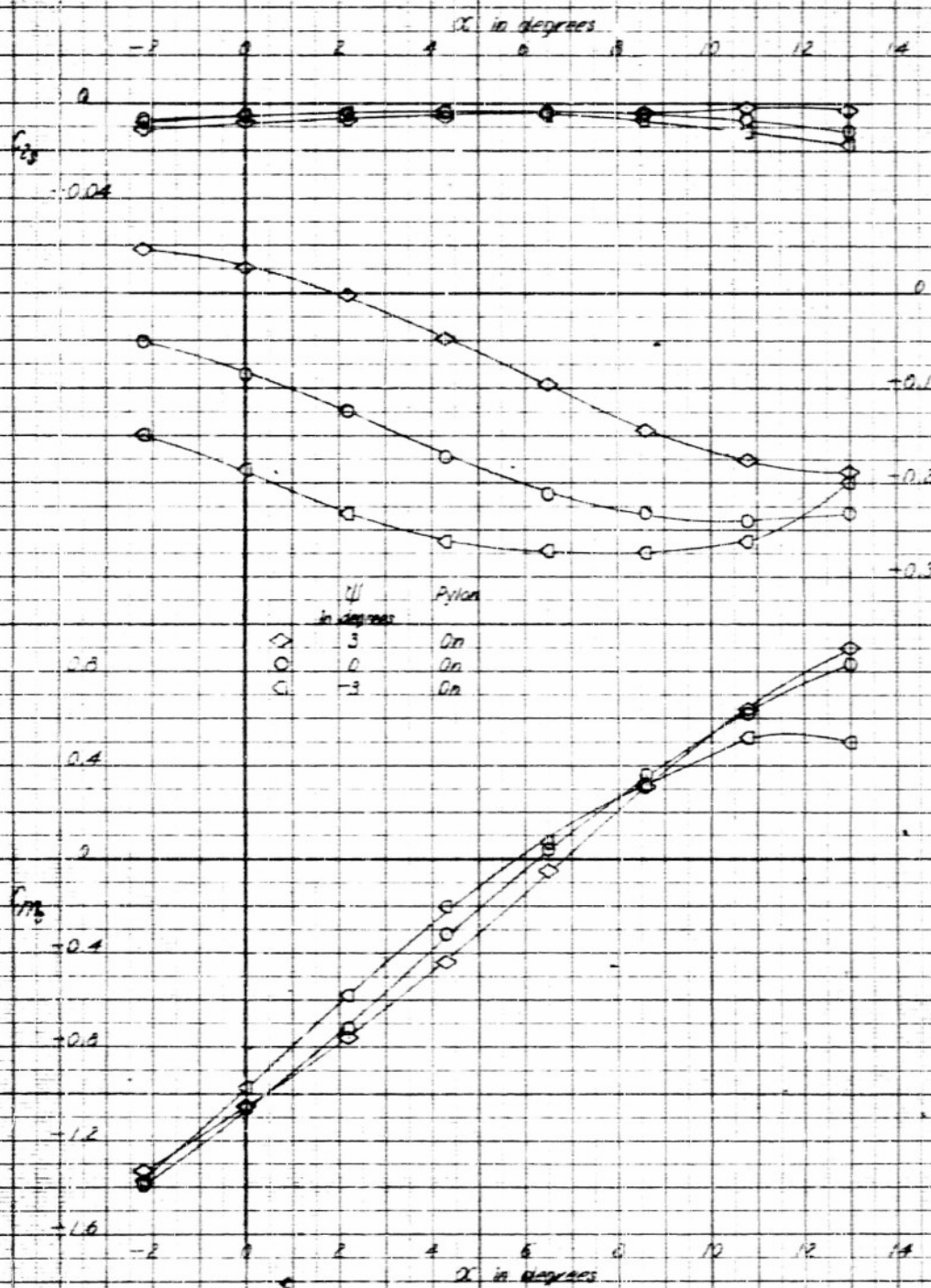


Figure 14 (Continued)

(Continued)

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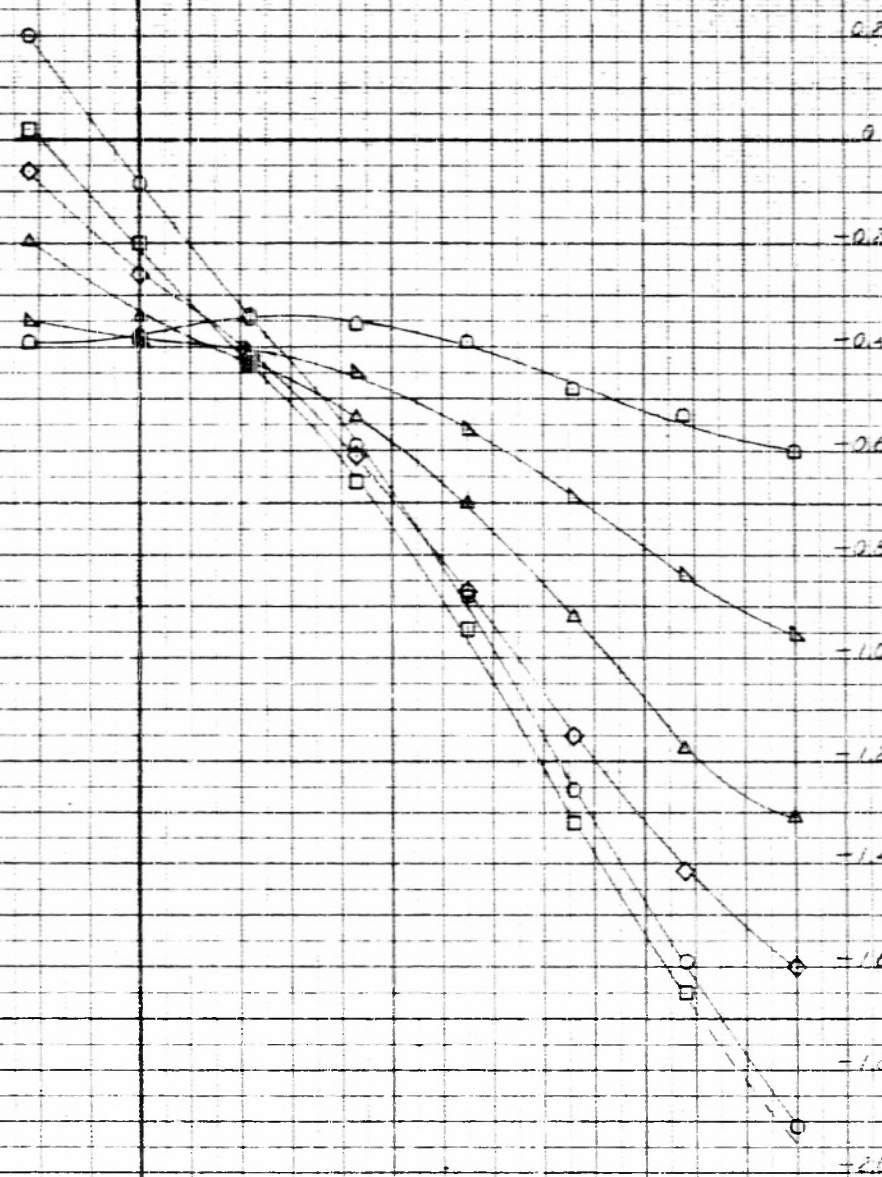
98-



SECTION 31

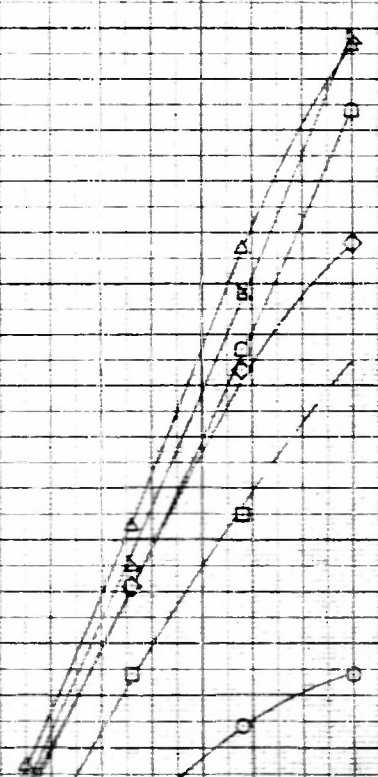
SECTION 32

$\alpha$  in Degrees



2.0  
1.8  
1.6  
1.4  
1.2  
1.0  
0.8  
0.6

$x$   
in inches:  
○ 18.36  
△ 13.26  
◇ 9.12  
□ 5.02  
○ 0



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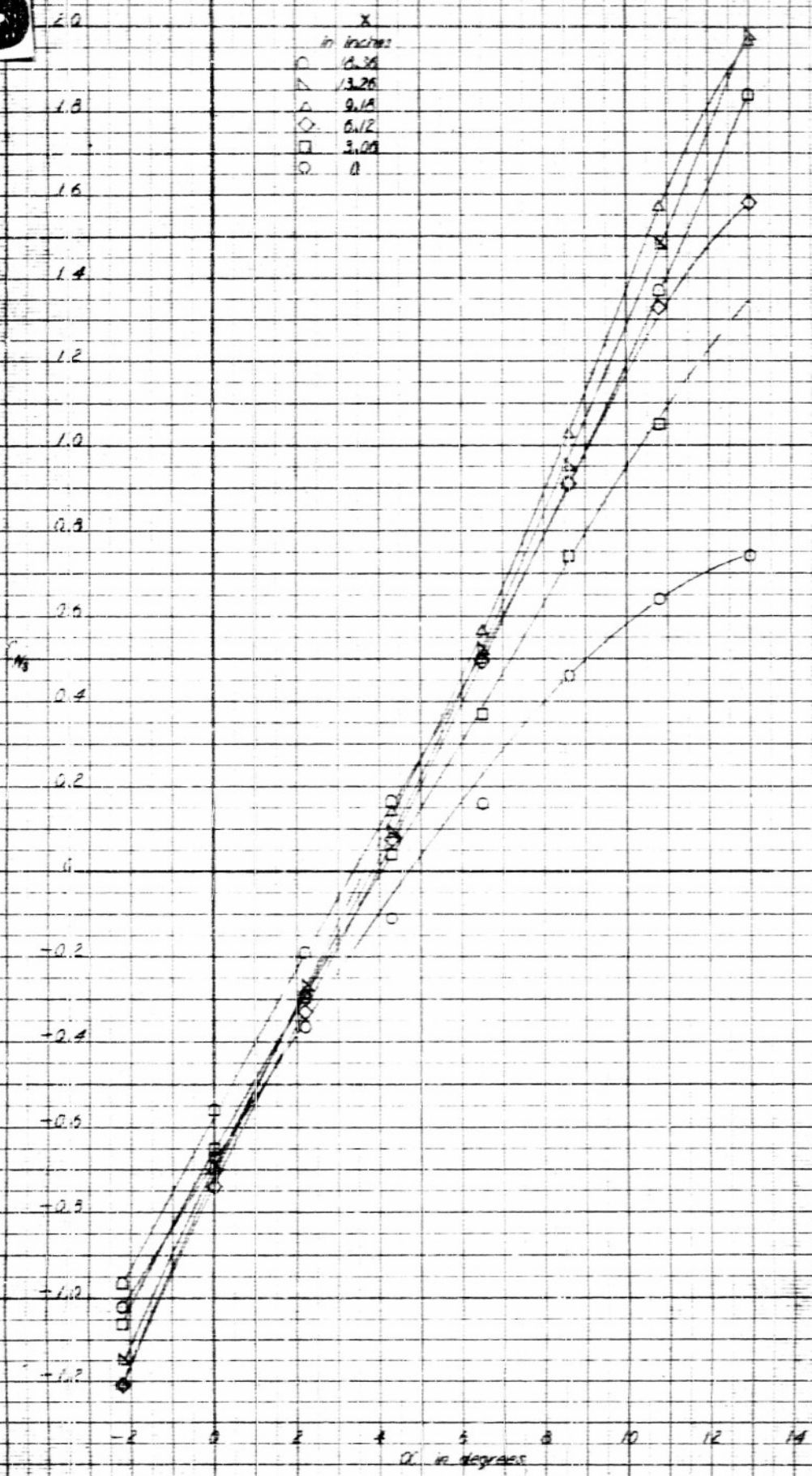


Figure 15-Aerodynamic Characteristics of a 0.17-Scale Model XA41-N-A  
Origin Missile for Various Distances Forward of the Carry Position  
in the Proximity of a 0.179-Scale Model F411-1  
Aircraft at the Outboard Station  
(a)  $z=0$  Inch,  $\beta=0^\circ$ ,  $\phi_0=0^\circ$ ,  $\psi=0^\circ$ , Aylton On

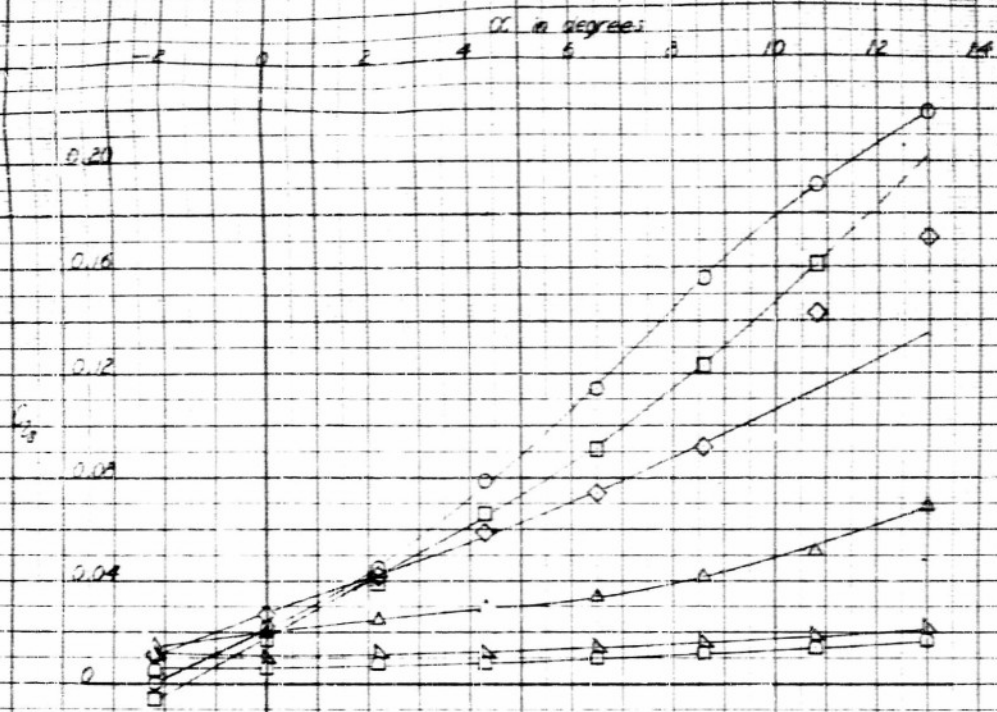
FIGURE 15A

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PROCESSES

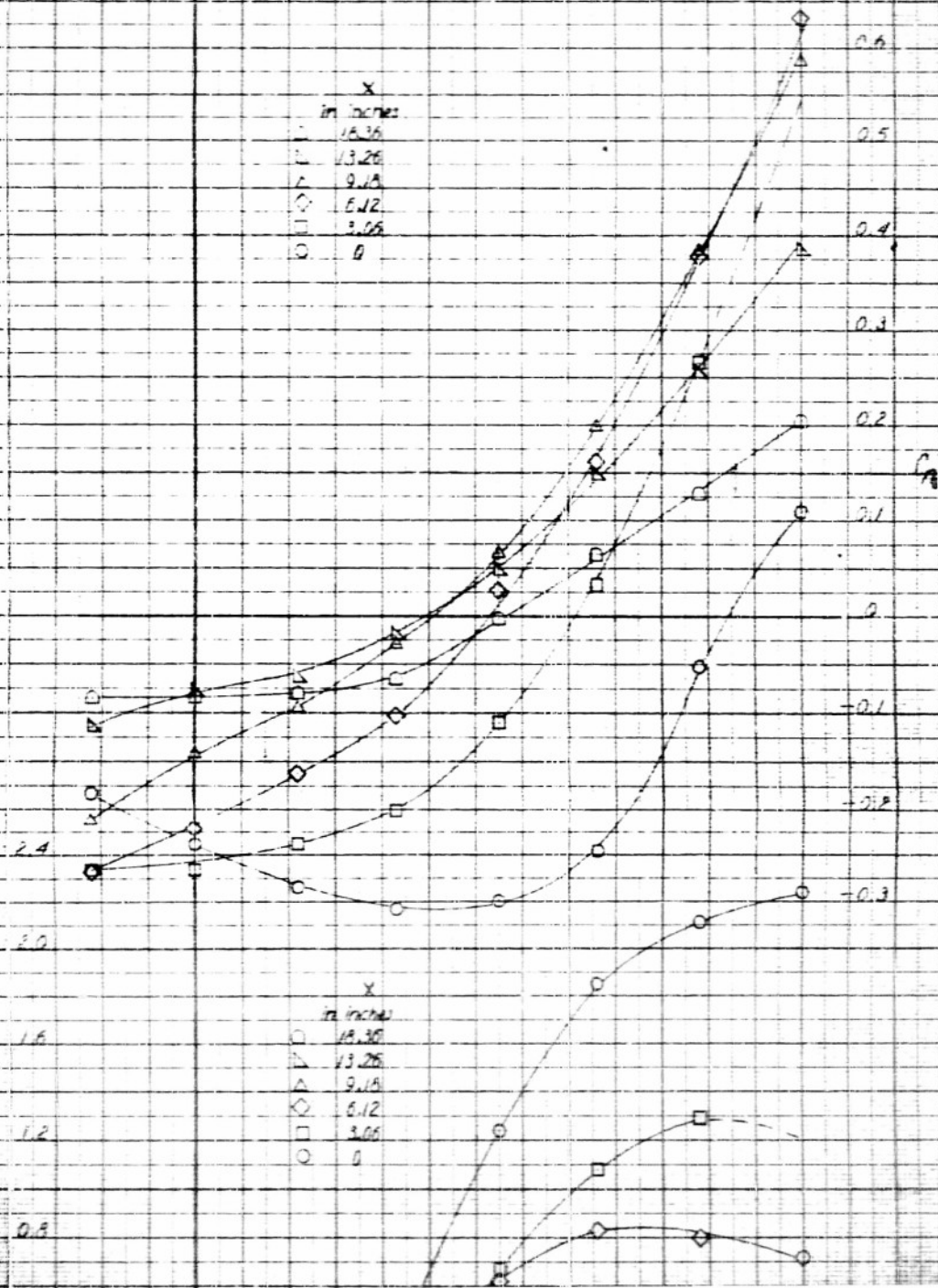
ANALYSIS



X  
in inches

○	15.36
□	13.26
△	9.15
◇	6.12
■	3.06
○	0

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X  
in inches

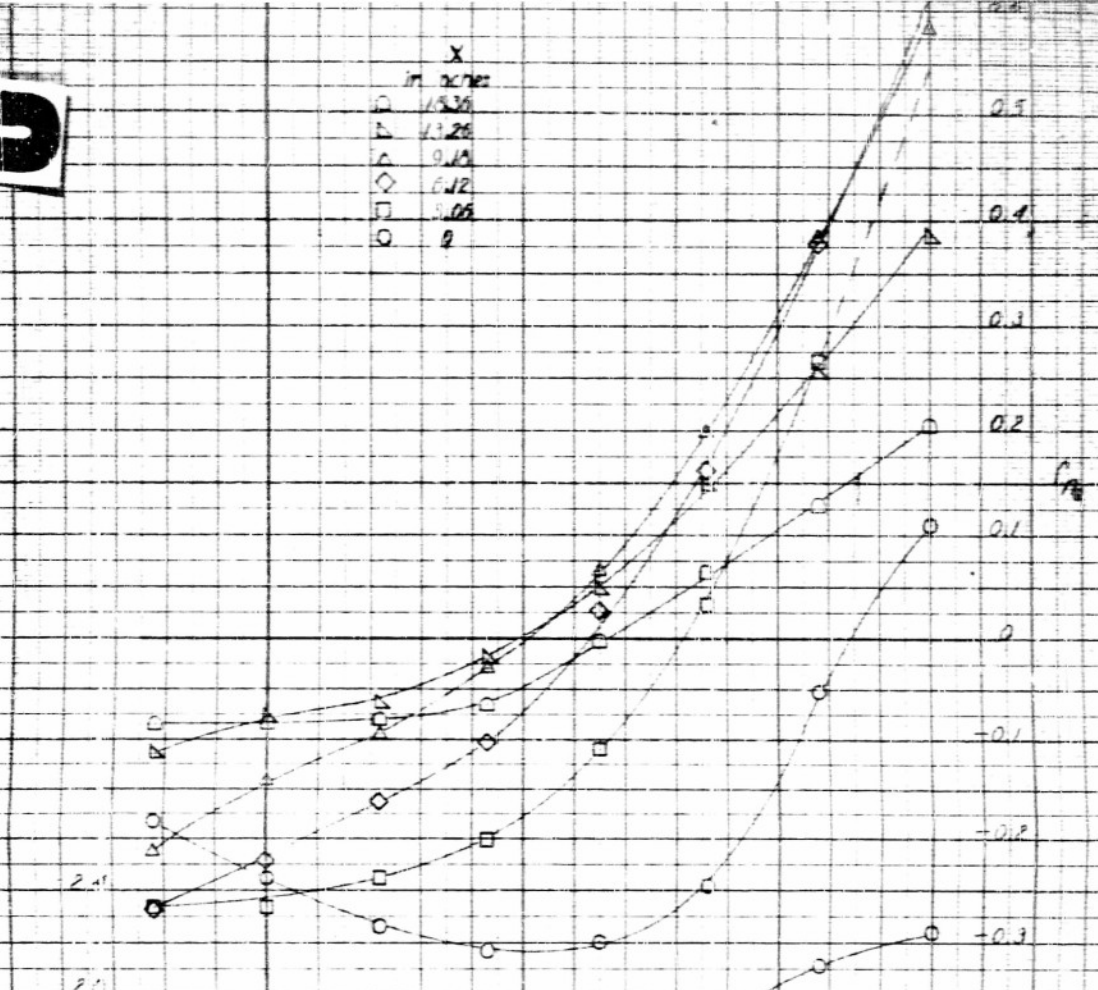
○	15.36
□	13.26
△	9.15
◇	6.12
■	3.06
○	0



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X	in inches
○	15.35
△	13.25
◇	9.15
□	6.12
○	3.06
○	0



X	in inches
○	15.35
△	13.25
◇	9.15
□	6.12
○	3.06
○	0

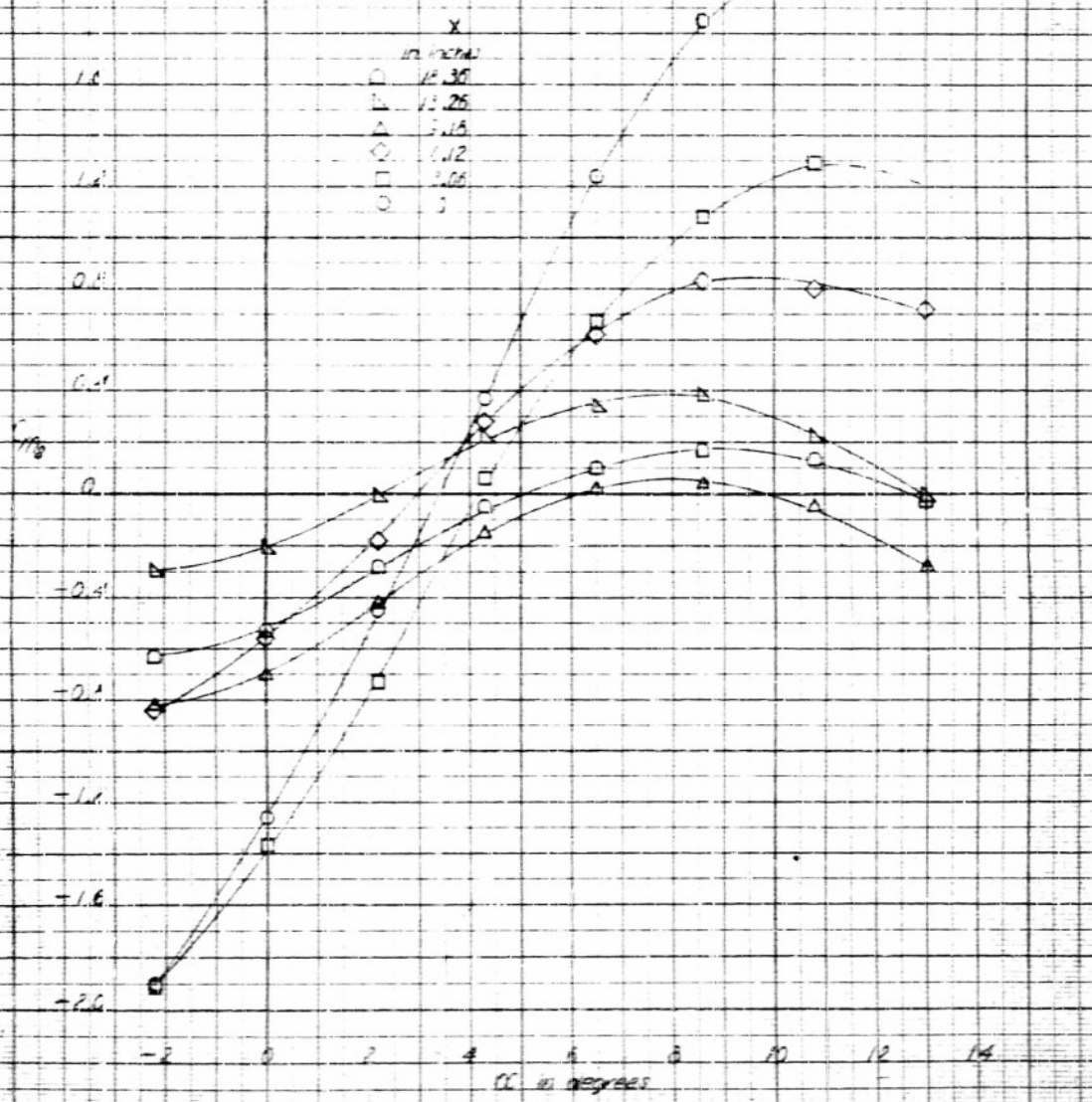


FIGURE 15 (a) (b)

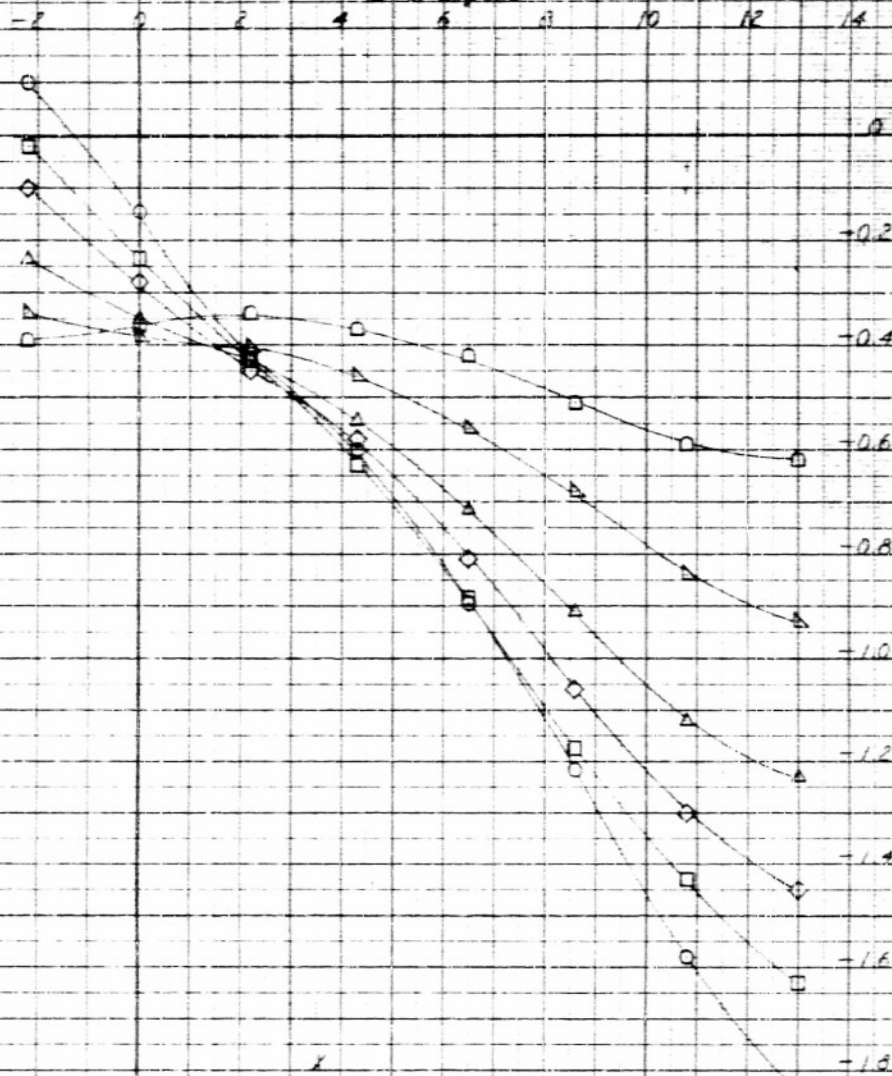
Figure 15 (Continued)  
(a) Continued

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PLATE 33

PLATE 34

$\alpha$  in degrees



$X$   
in inches

- $\square$  12.36
- $\square$  13.26
- $\triangle$  2.12
- $\circ$  2.12
- $\square$  3.06
- $\circ$  0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

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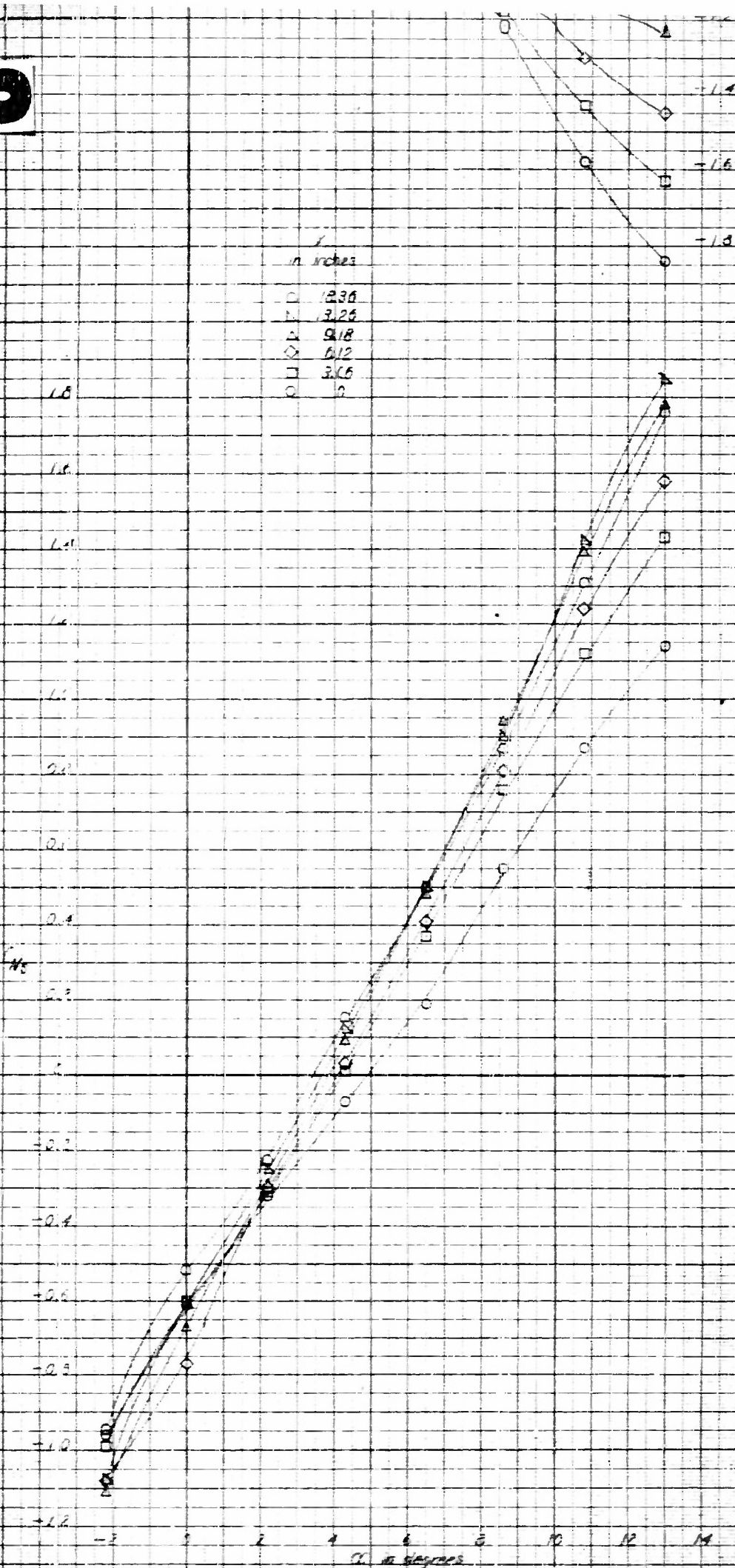


Figure 15 (Continued)

$r = 1.0$  inches,  $q_c = 0$ ,  $\psi_s = 0$ ,  $\psi_b = 0$ ,  $P_{yden} = 0$

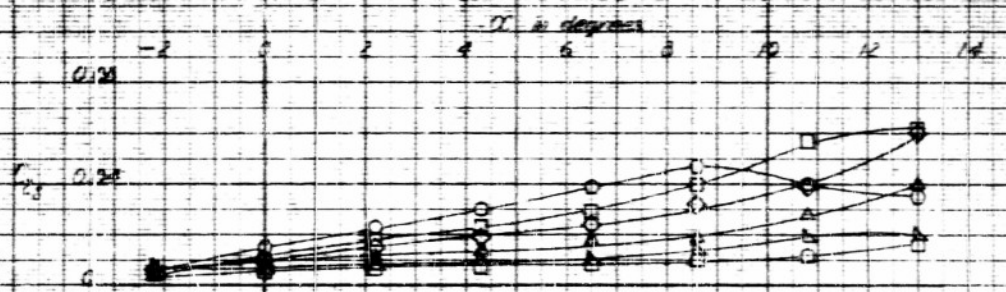
FIGURE 15

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$r$   
in inches  
 ○ 0.25  
 △ 0.26  
 ◇ 0.27  
 □ 0.28  
 ○ 0.29

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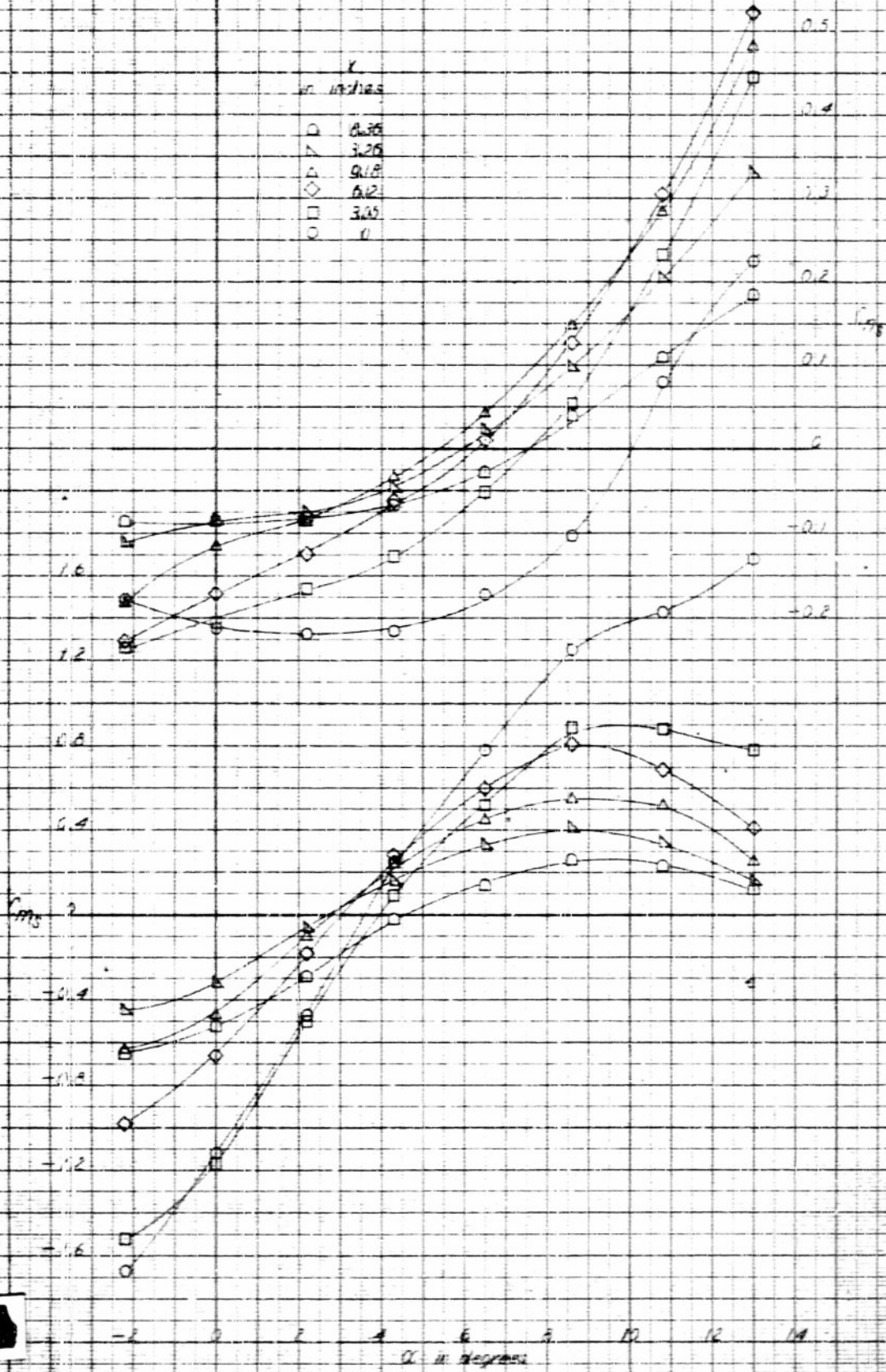
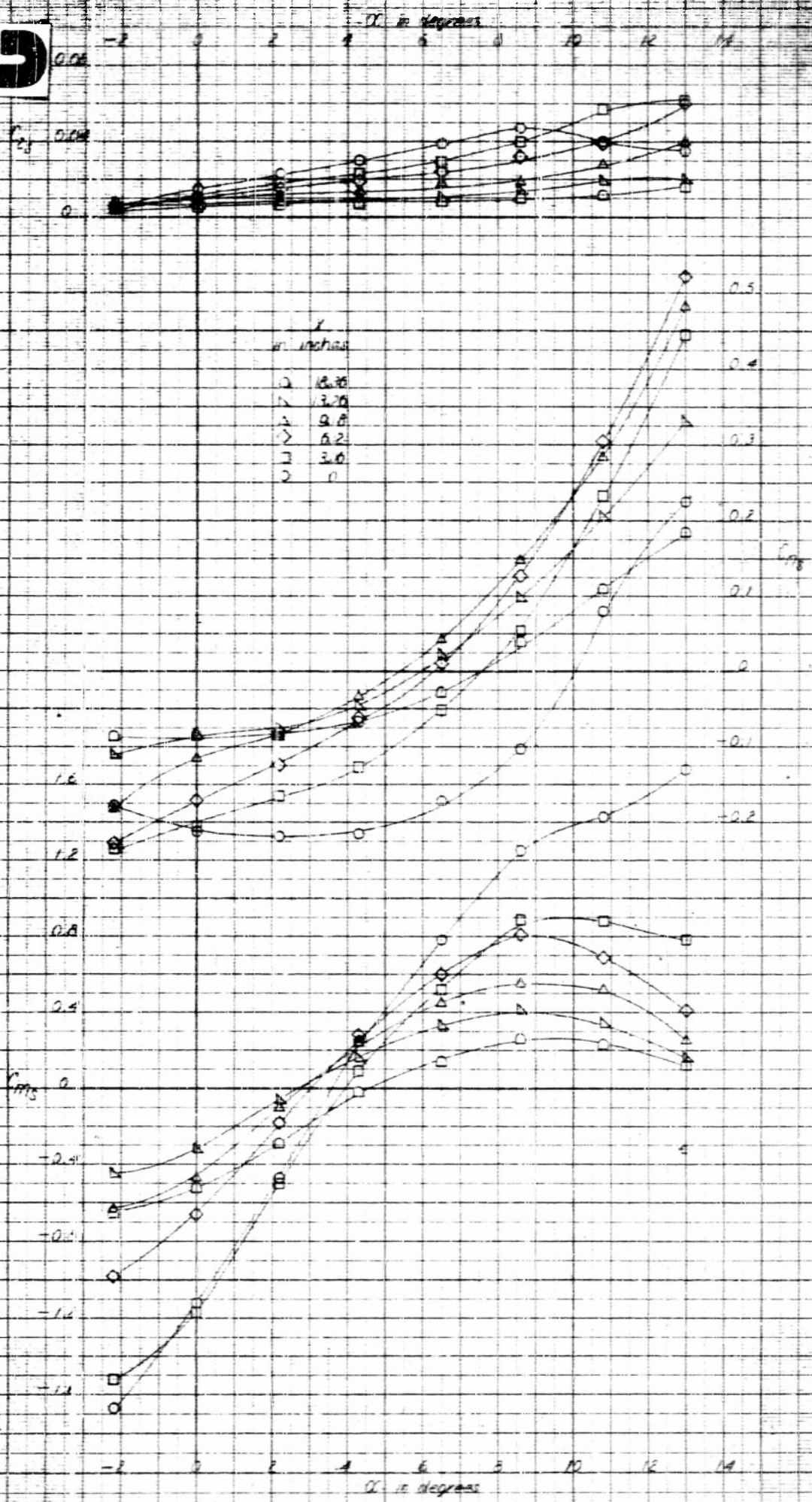


FIGURE 15 (Continued)

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Figure 15 (Continued)  
g) Consolidated

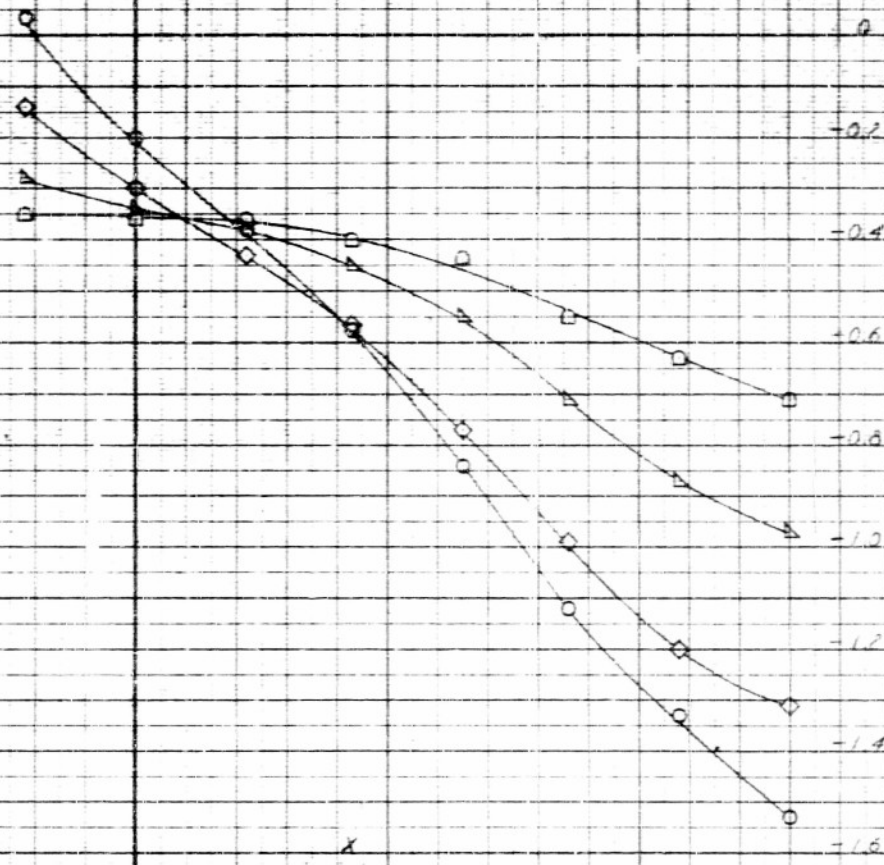


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100 in inches

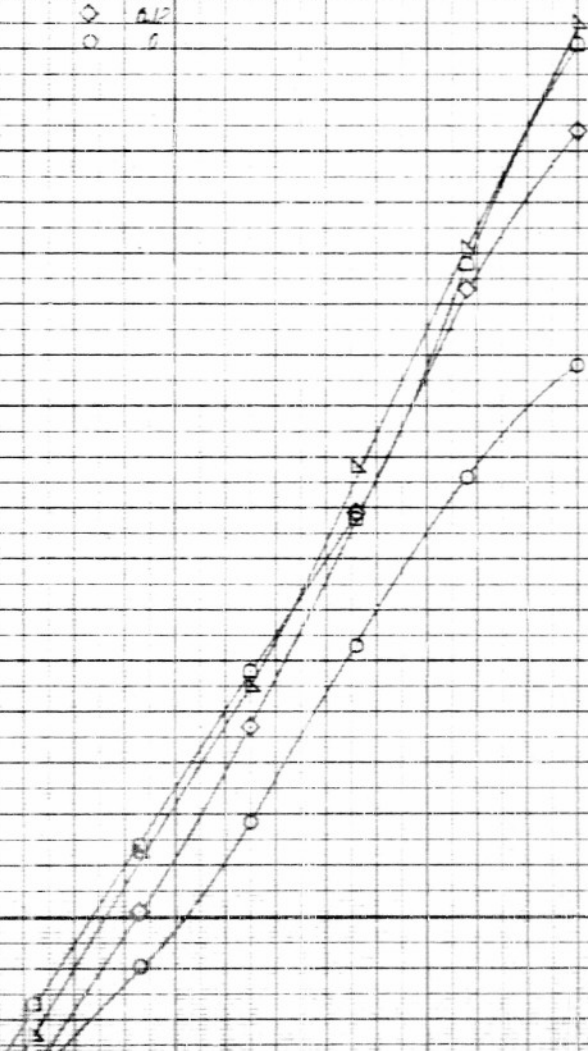
-2 0 2 4 6 8 10 12 14



X  
in inches  
18.36  
17.24  
16.12  
15.0

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1.8  
1.6  
1.4  
1.2  
1.0  
0.8  
0.6  
0.4  
0.2  
0  
0.2





2

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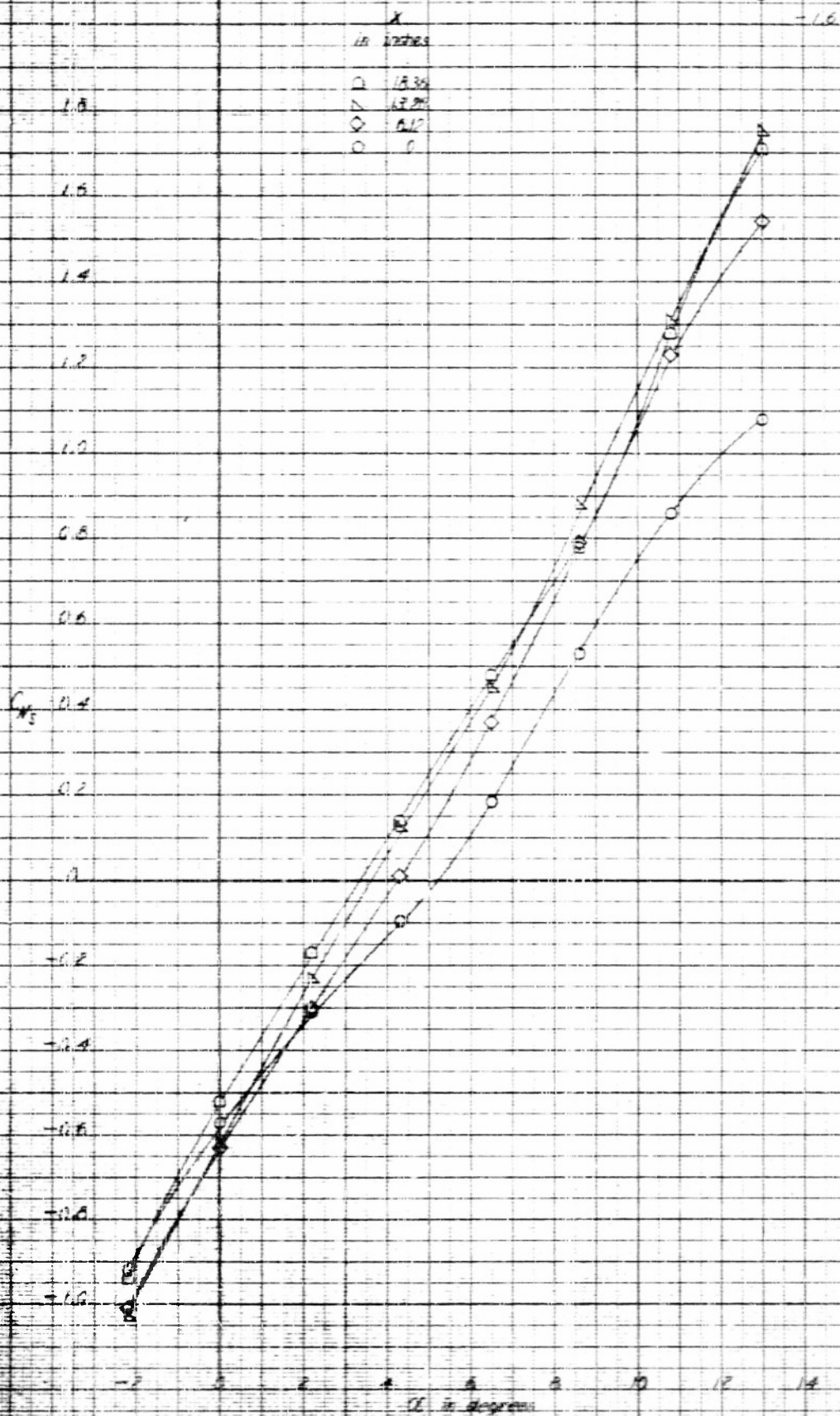


Figure 15 (continued)

$h_2 = 2.04$  inches,  $R_0 = 0$ ,  $R_1 = 3.16$  ft, Pylon On

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FIGURE 15a (contd)

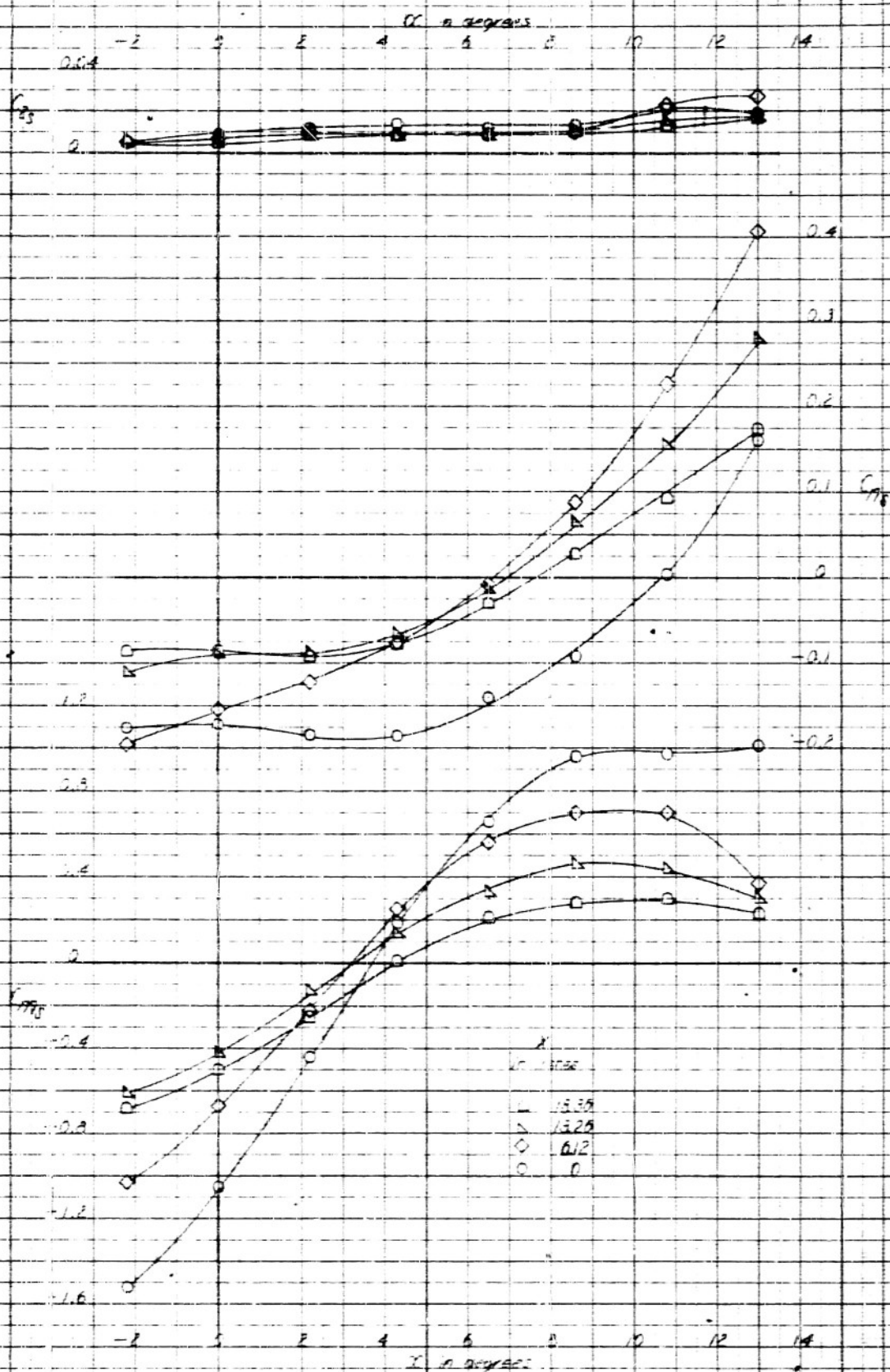
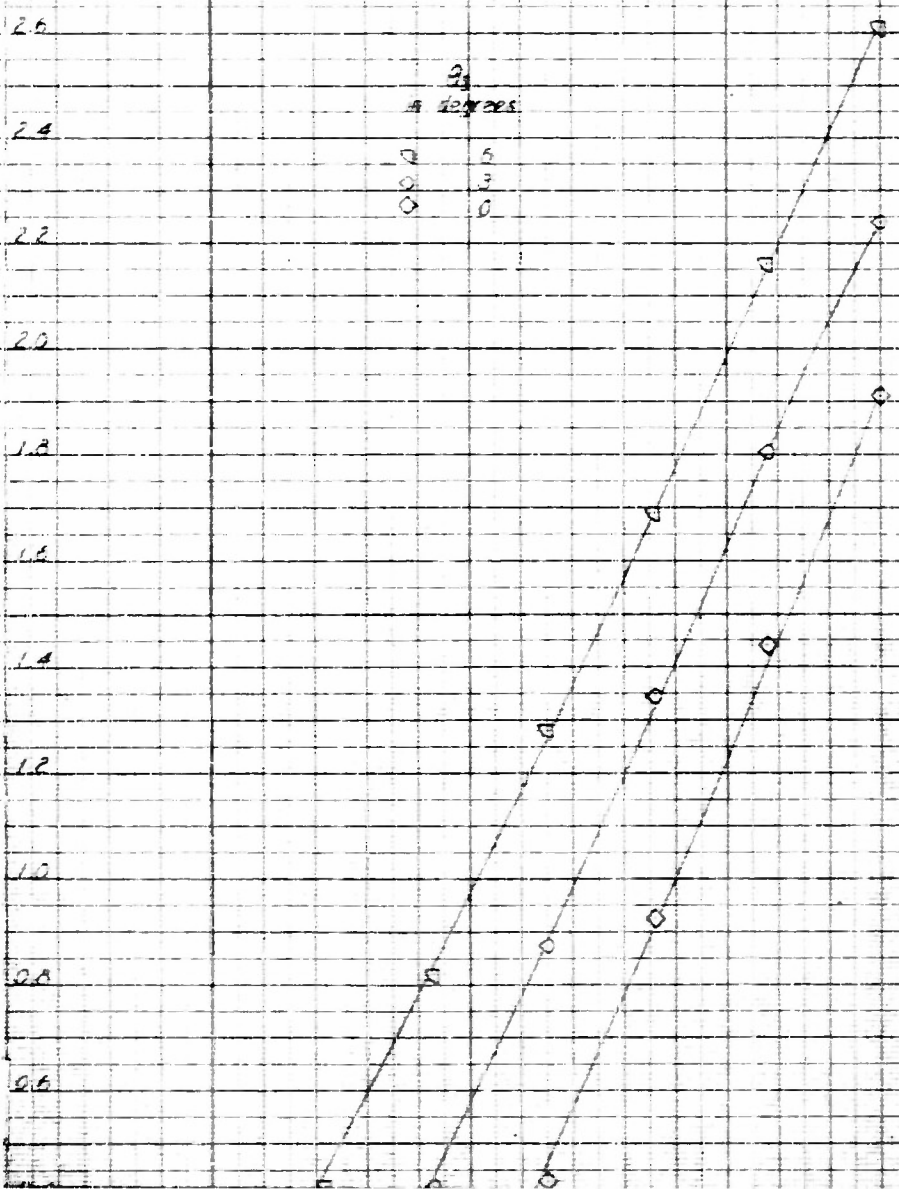
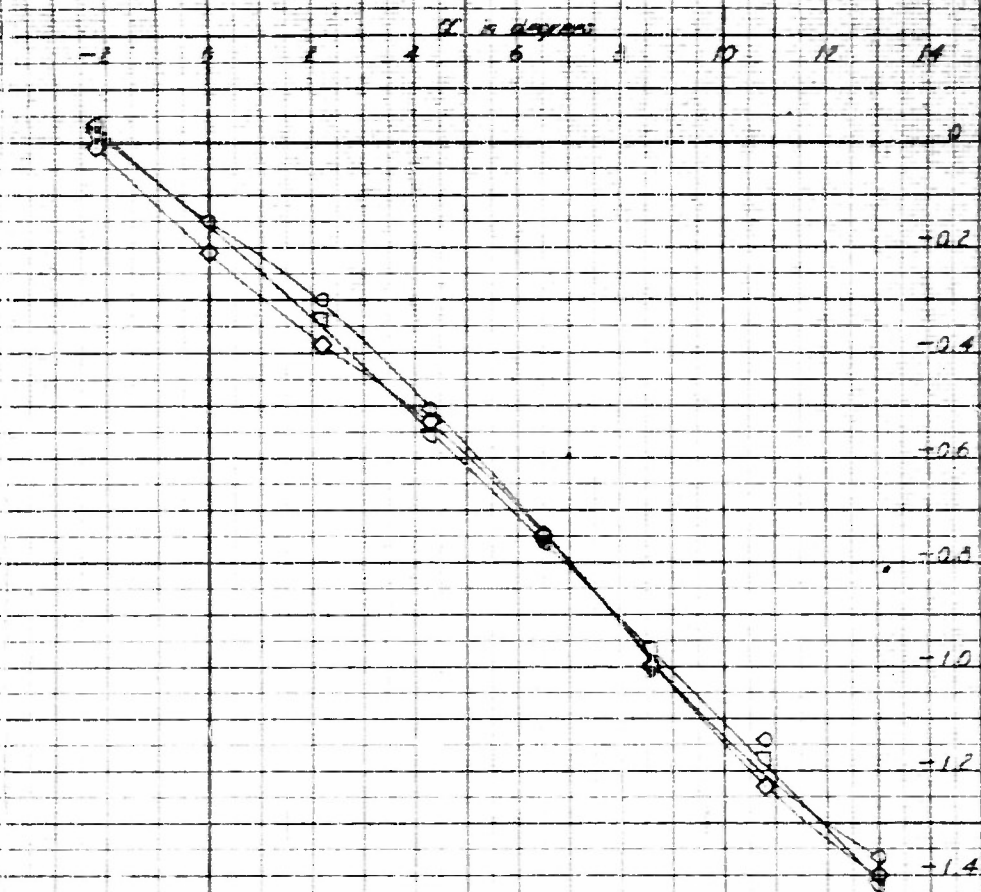


Figure 15 (Continued)  
(b) Continued

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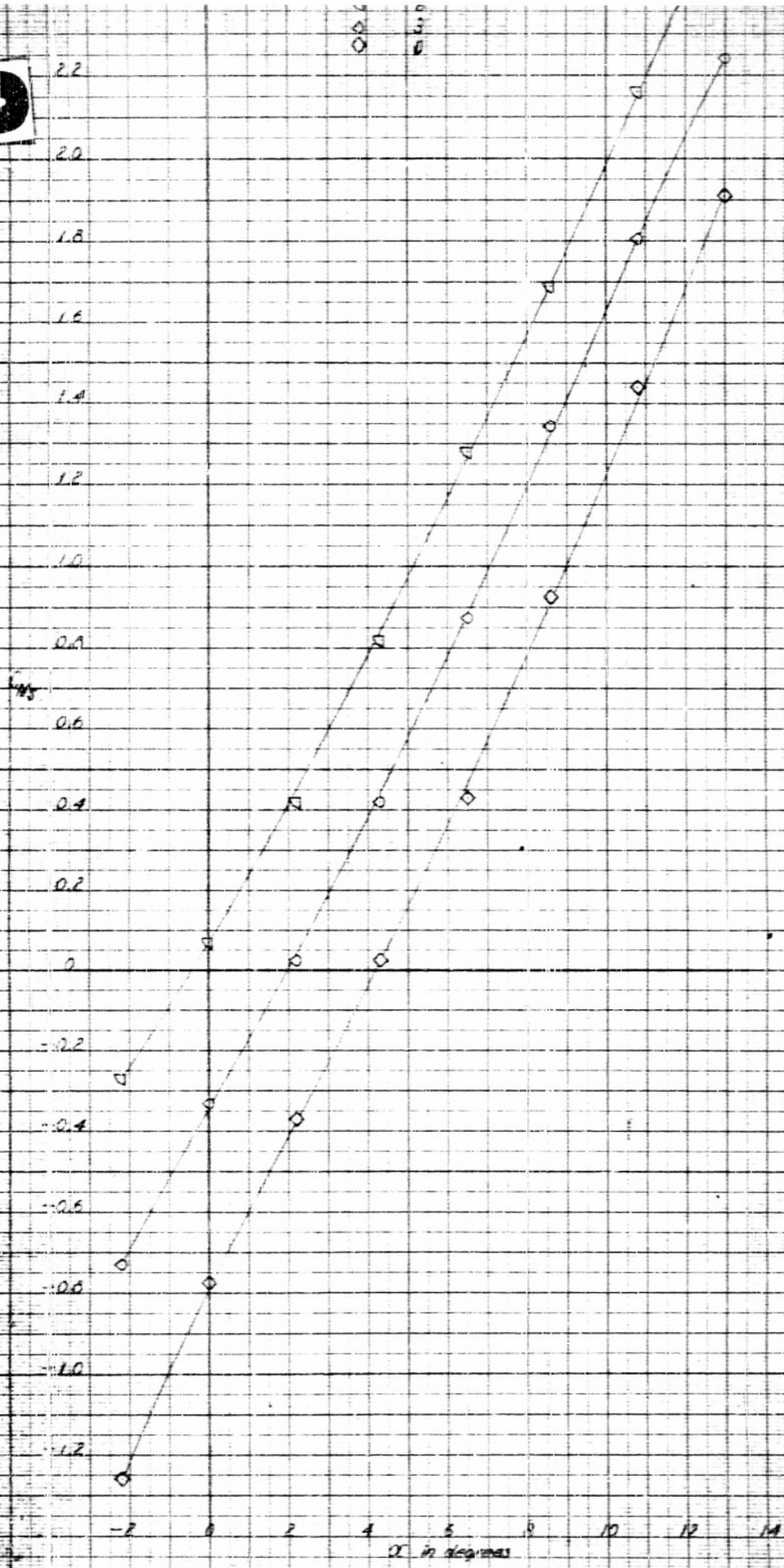


Figure 10 - Aerodynamic Characteristics of a 0.17-Scale Model XAAM-N-8  
 Cruise Missile Test in Missile Pitch in the Proximity of a 0.179-Scale  
 Model F4D-1 Airplane at The Orbital Station  
 (a)  $z=0$  inch,  $y=0.12$  inches,  $C_D=C_{D0}=40 \pm 10$ , Eylon Off

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FIGURE 10 (continued)

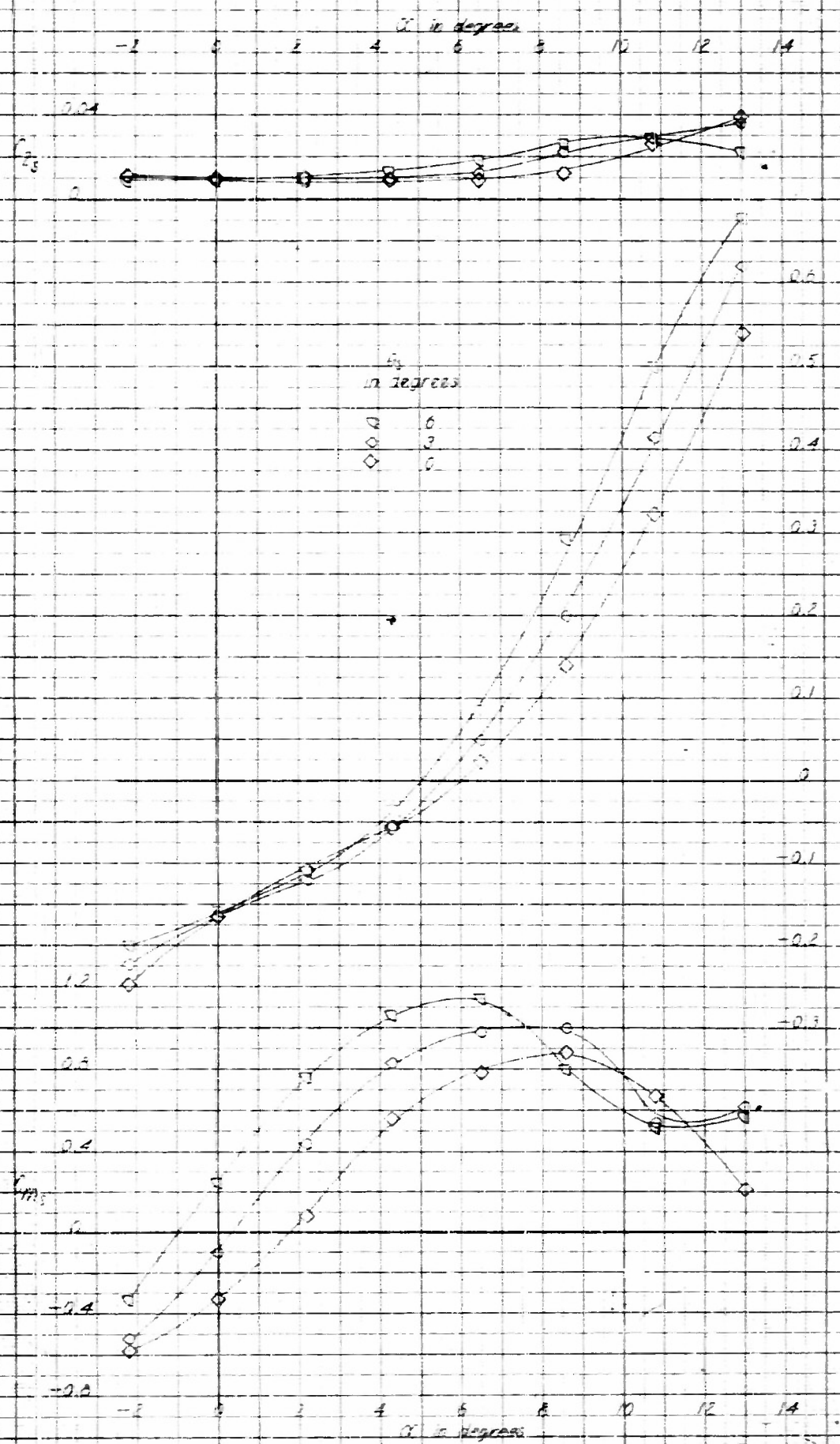


Figure 10 (Continued)  
(a) Continued

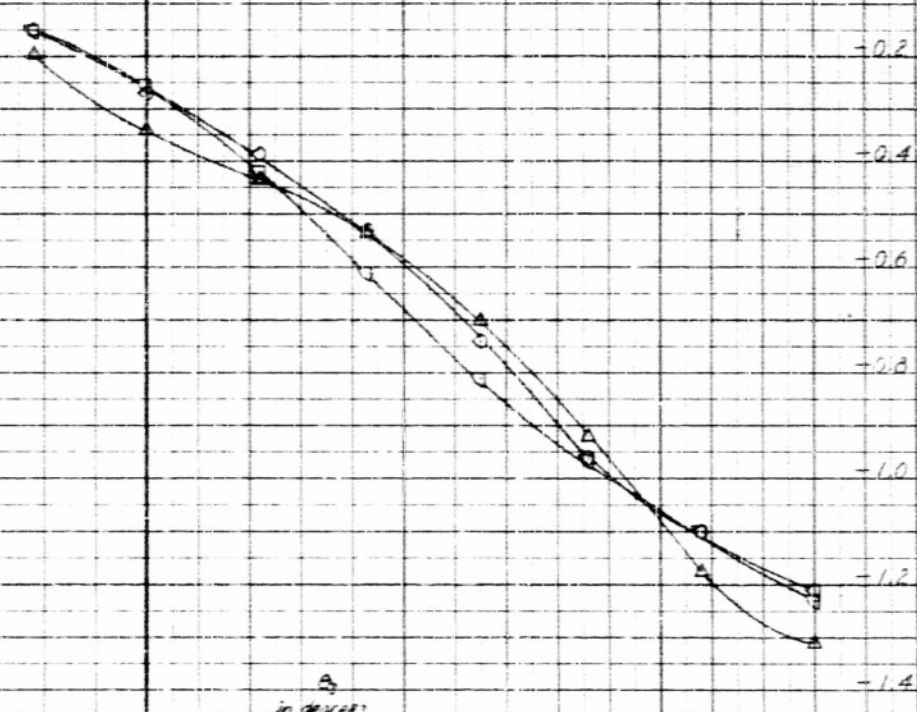
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AERO 864

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14



A  
in degrees  
□ 2  
○ 3  
△ 4

2.6

2.4

2.2

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

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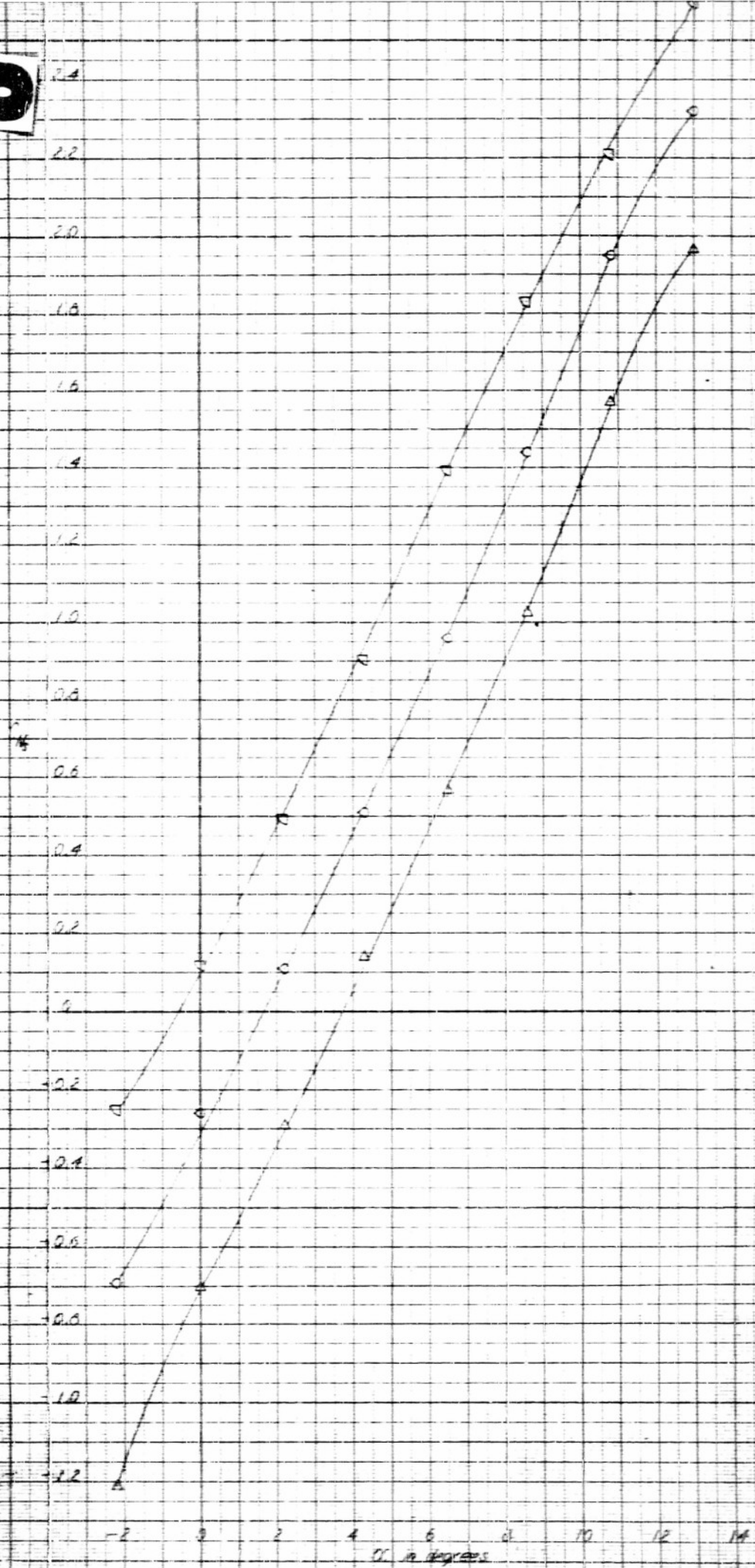


Figure 10 (Continued)

(b)  $r=2$  Inch,  $x=3.16$  Inches,  $\beta_1=0^\circ$ ,  $\beta_2=0^\circ$ , Pylon On

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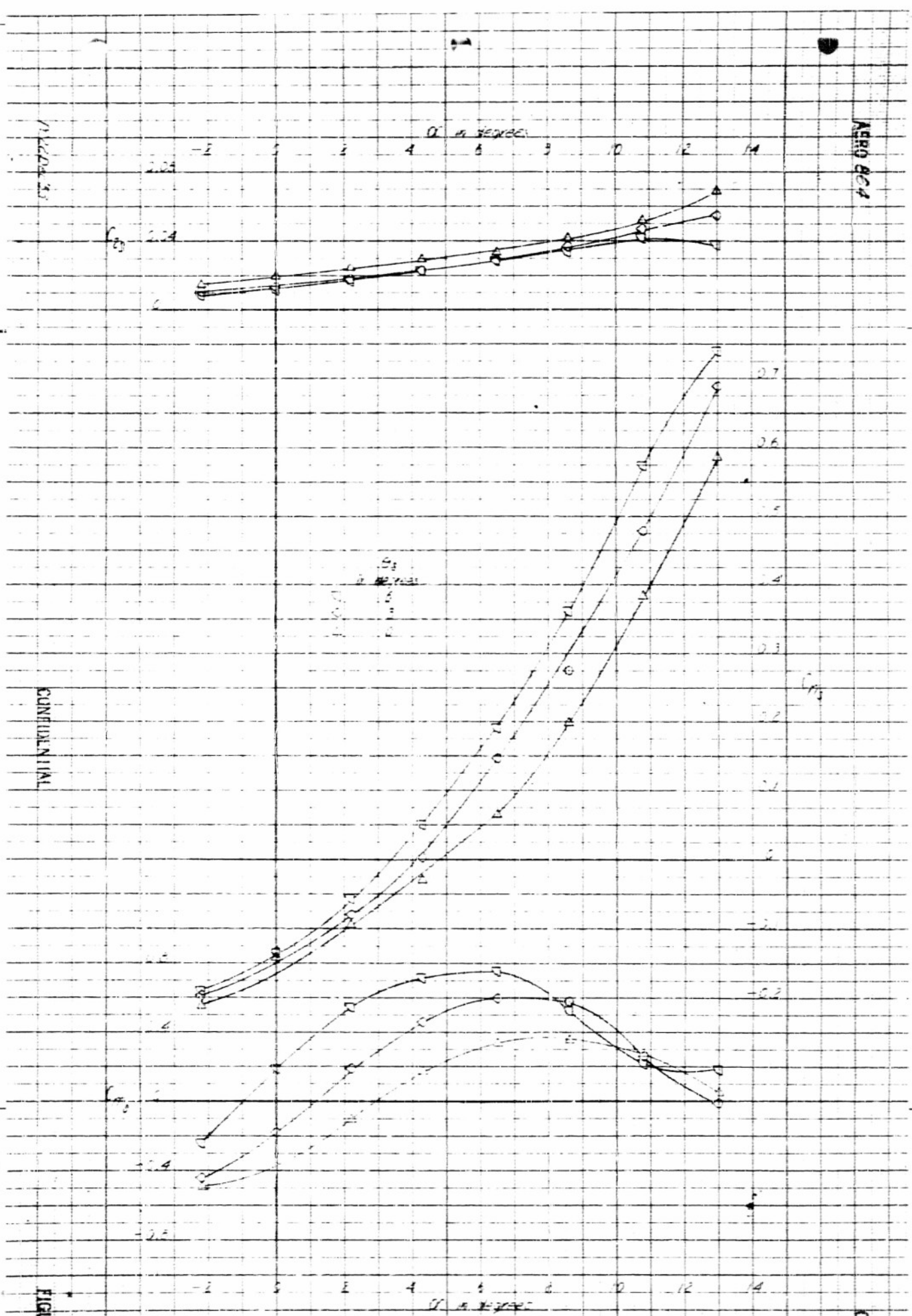


Figure 16 (Continued)

(b) Conclusions

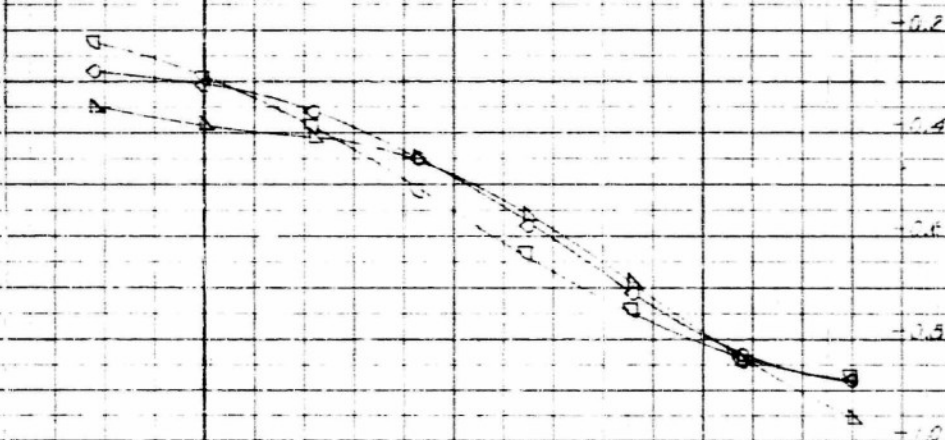
FIGURE 16 (b) Conclusions

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10. H. Degree



10. H. Degree

2.4

2.2

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

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1



2

$\theta$ , degrees  
 $\Delta$  5  
 $\circ$  3  
 $\Delta$  0

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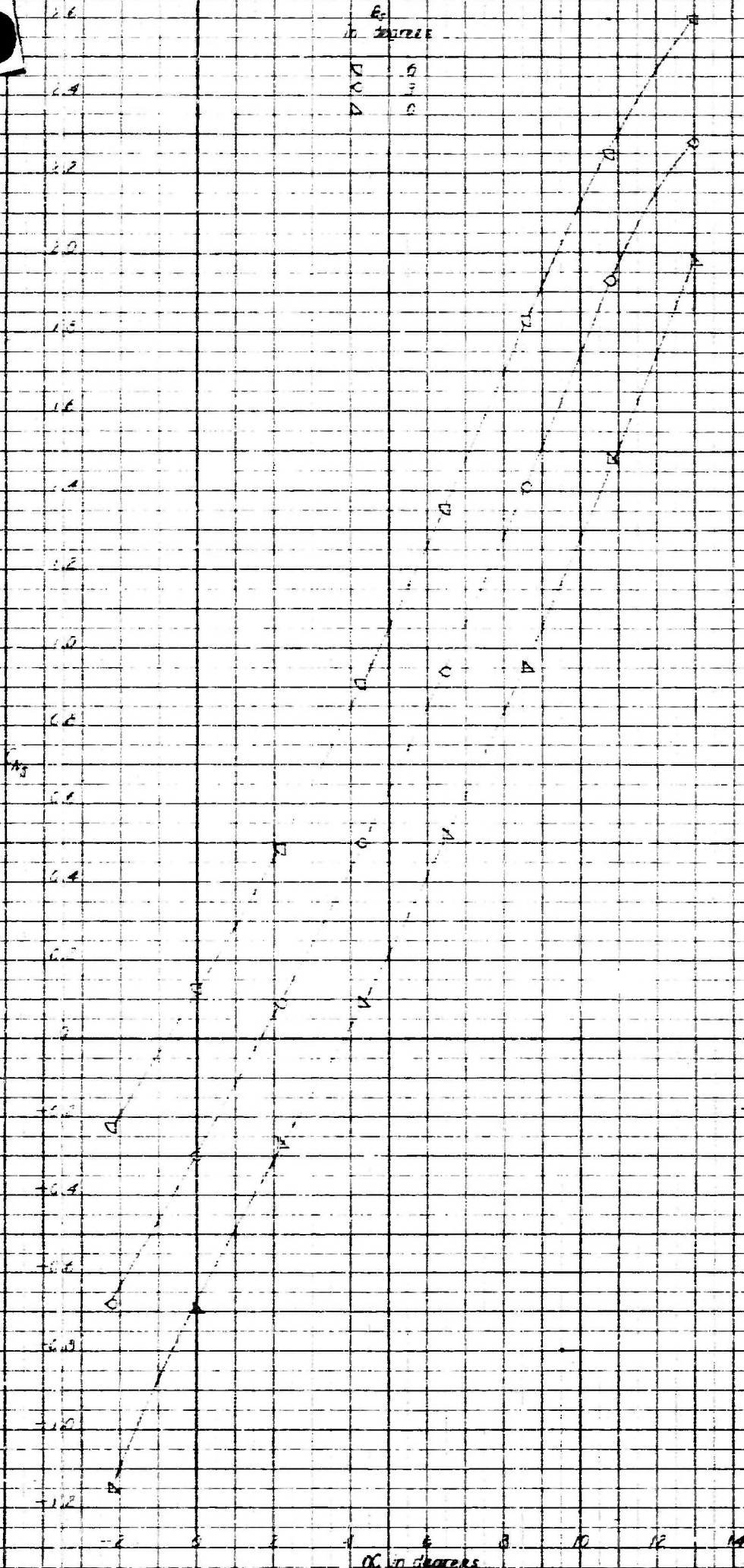


FIGURE 16 C

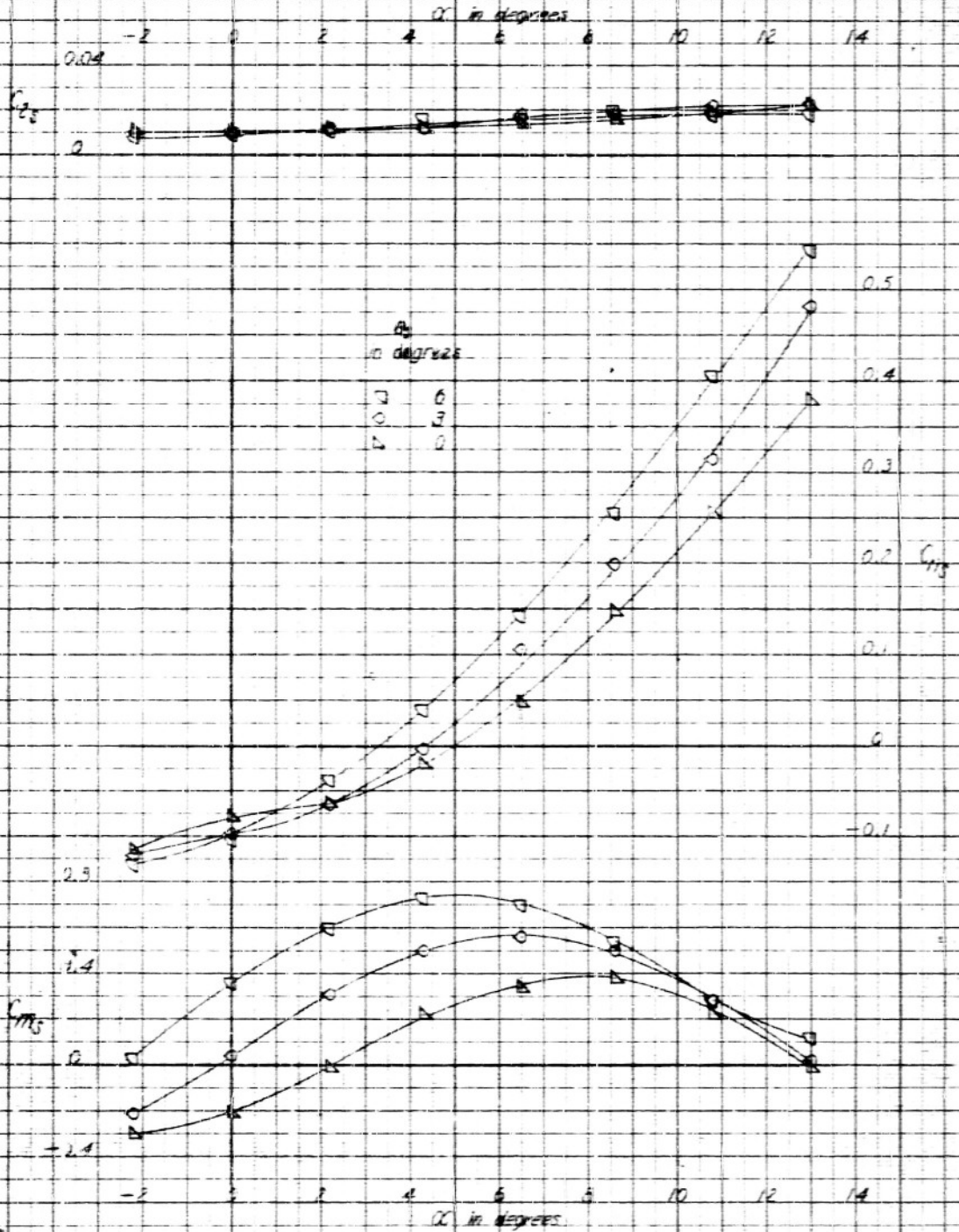
Figure 16 (Continued)

$z = 0$  inch,  $x = 13.26$  inches,  $\theta_1 = 0^\circ$ ,  $\theta_2 = 0^\circ$ , Pylon On

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AR 20-4



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FIGURE 16 (continued)

Figure 16 (continued)  
6. Concluded

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AERO 66

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

-0.2

-0.4

-0.6

2.6

2.4

2.2

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

0

-0.2

-0.4

$R_p$   
in degrees

□ 6  
○ 3  
◇ 0  
△ -3  
▽ -5

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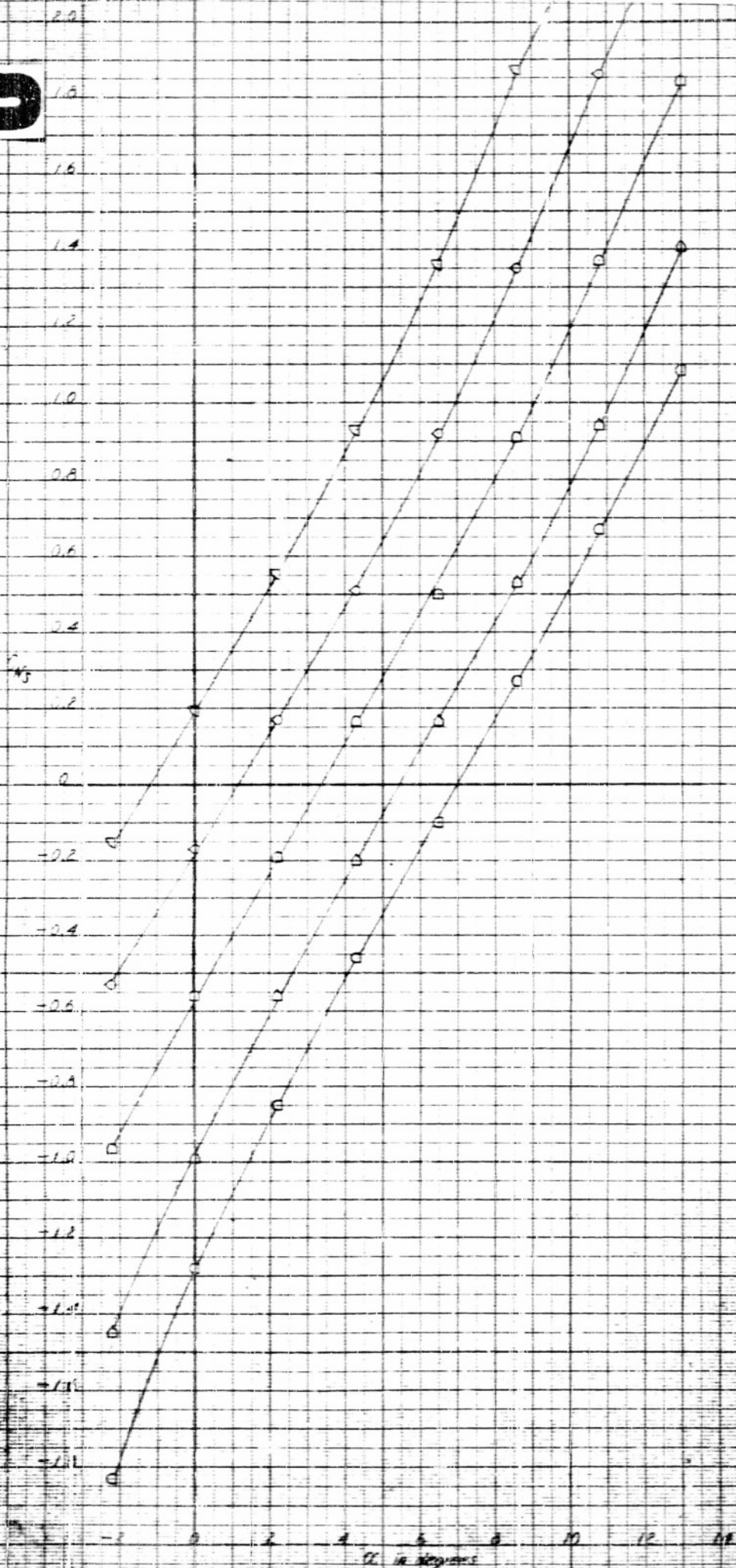


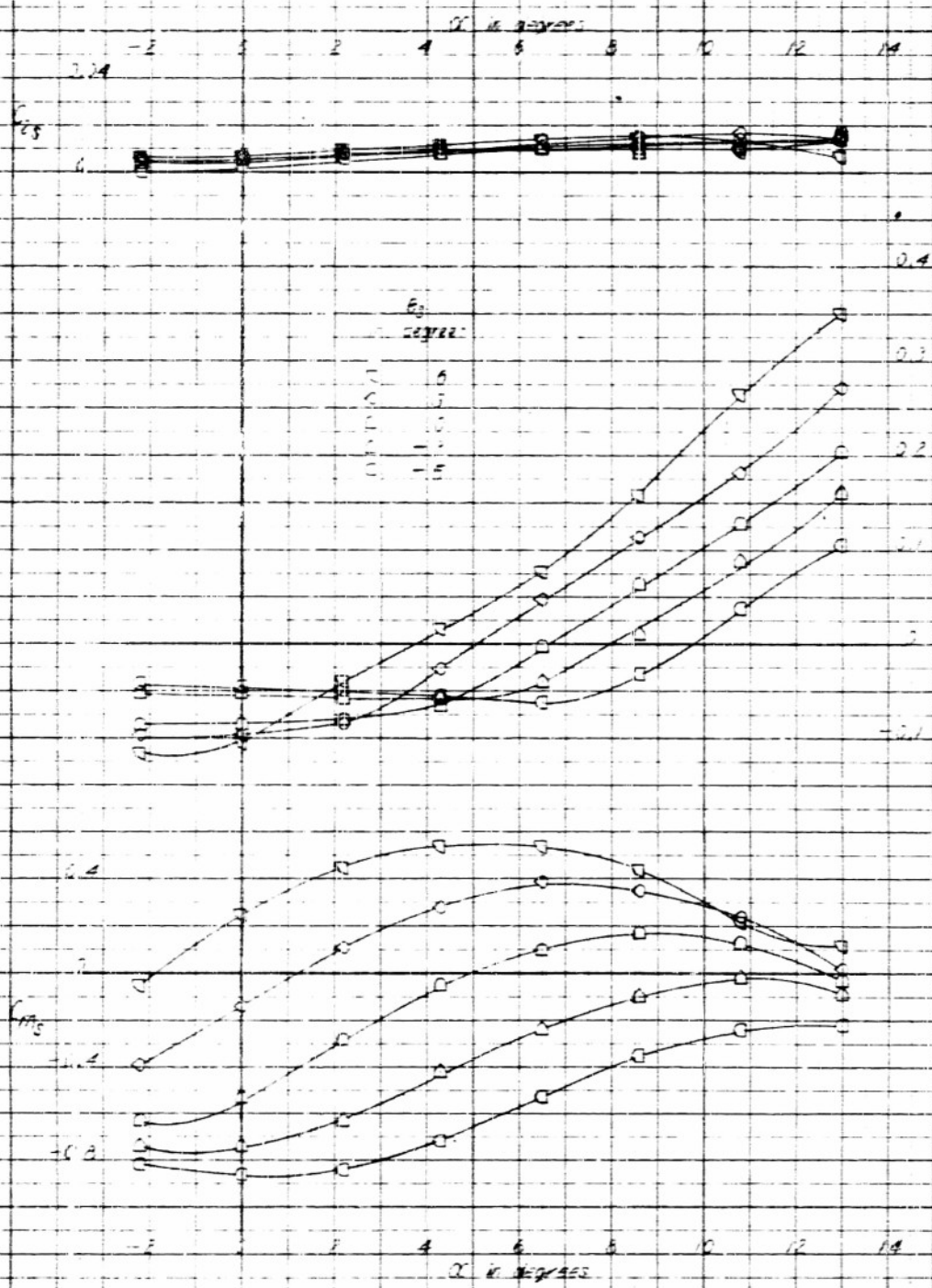
Figure 16 (Continued)

(1)  $\alpha = 0$  to  $14$ ,  $\lambda = 11.36$  inches,  $\omega = 17$ ,  $\theta = 0$ ,  $P_{\text{dyn}} = 0$

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interpolated



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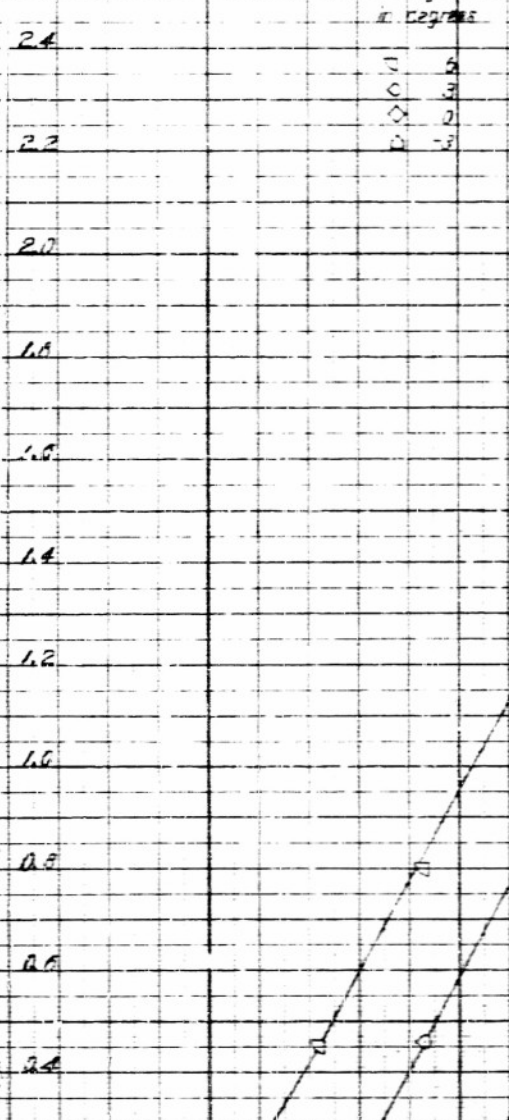
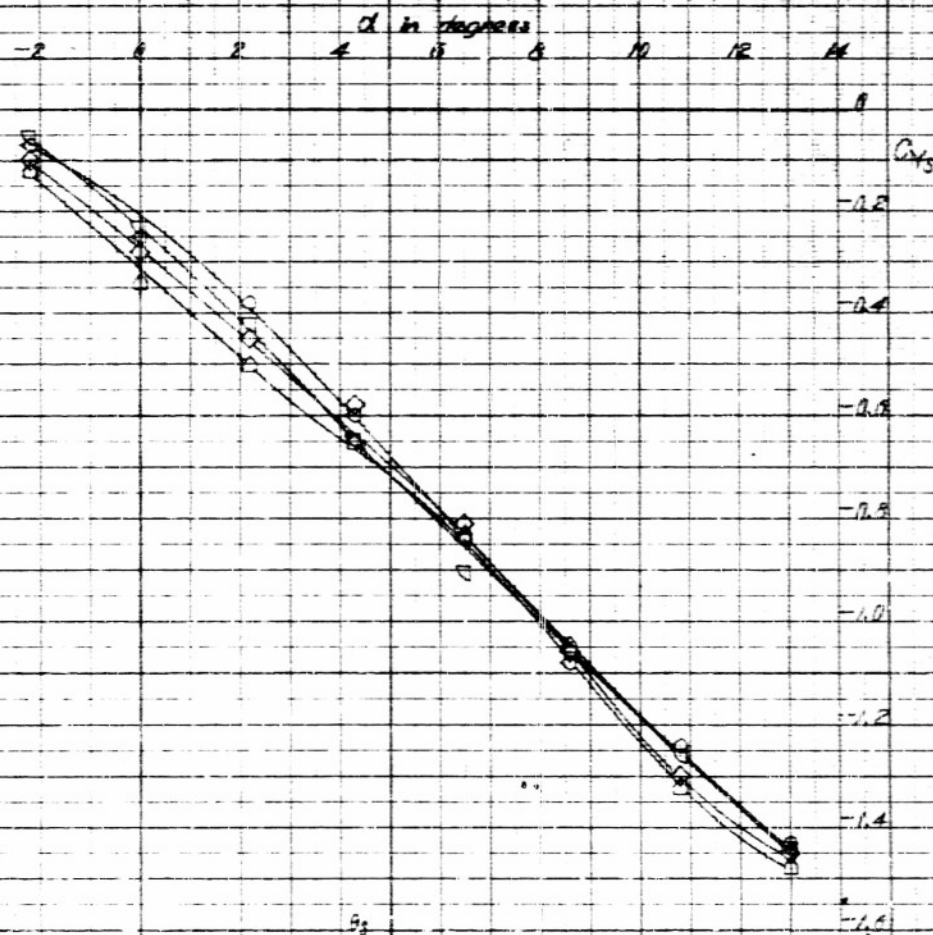
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Figure 16 (Continued)  
 (b) Concluded

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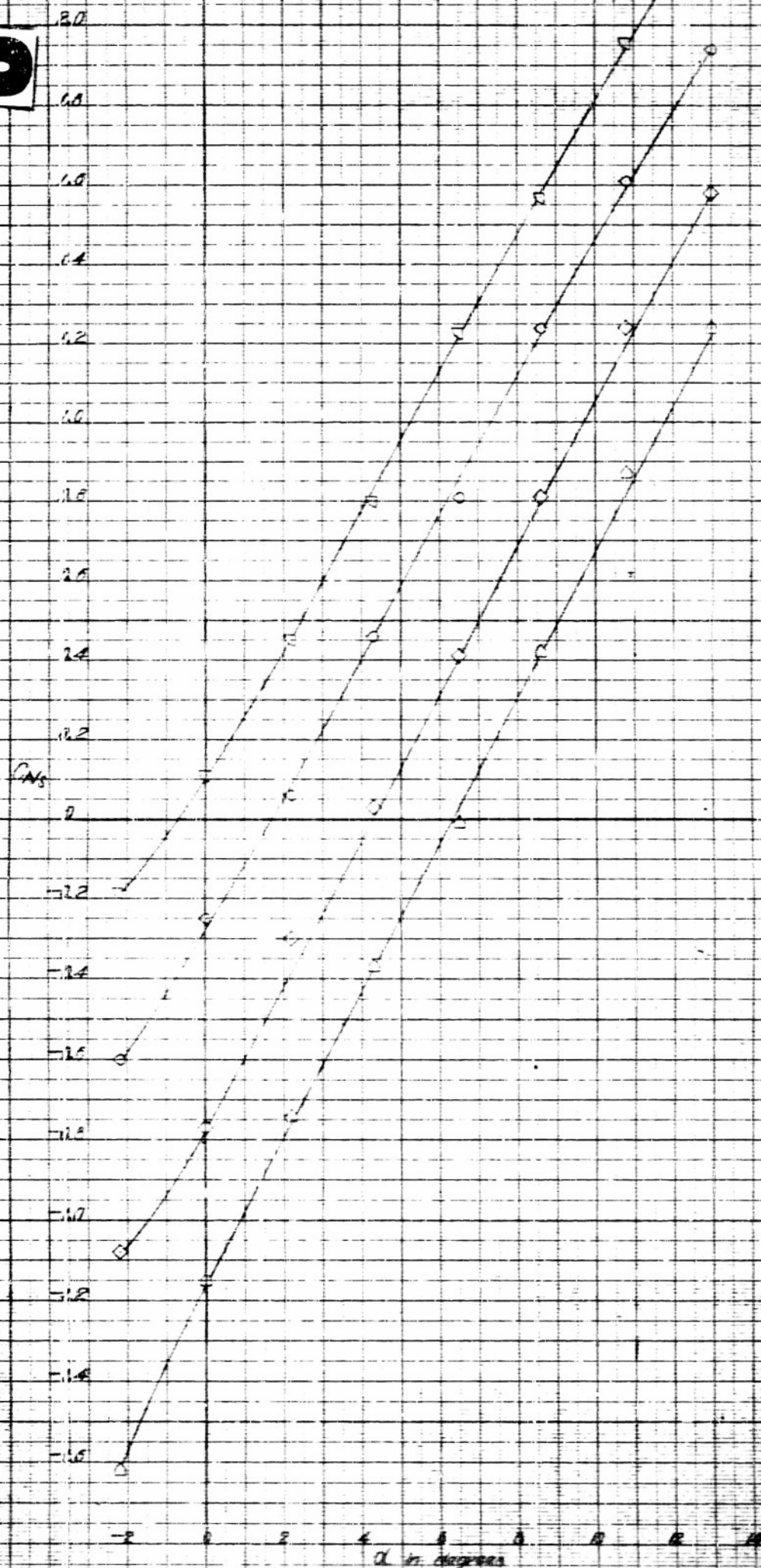


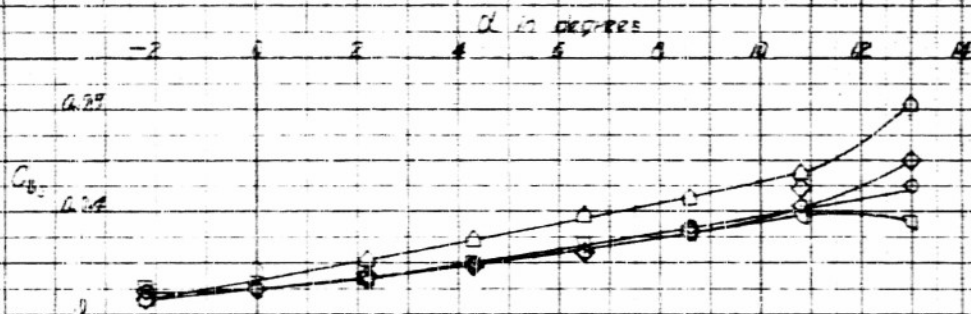
Figure 12 (Continued)

(2)  $Z = 1.12$  Inches,  $x = 0.12$  Inches,  $V_0 = 0$ ,  $V_1 = 0$ ,  $P_0 = 0$

FIGURE 12

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$C_L$  in degrees  
 1. 0  
 2. 1  
 3. 2  
 4. 3

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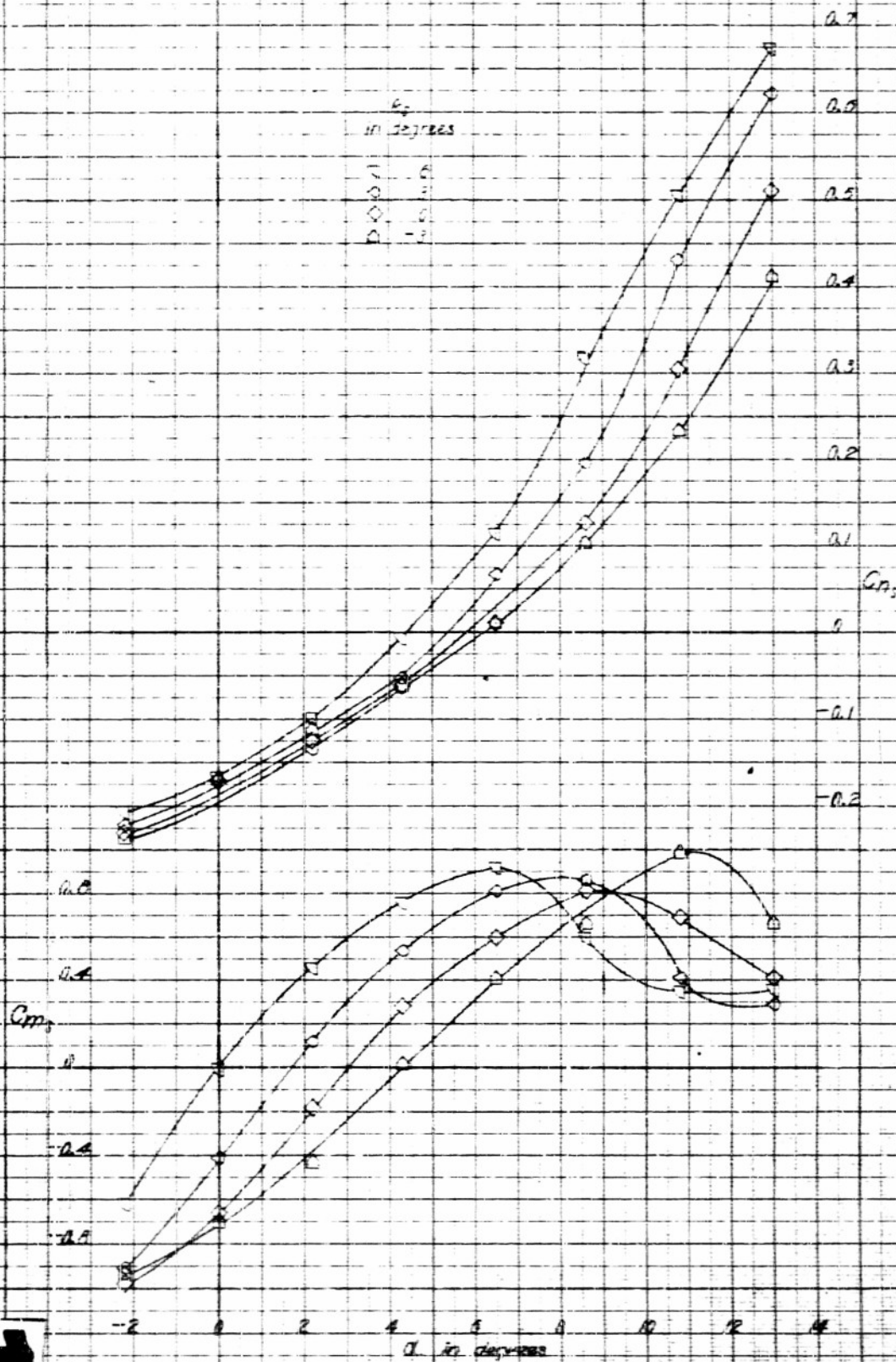


FIGURE 1

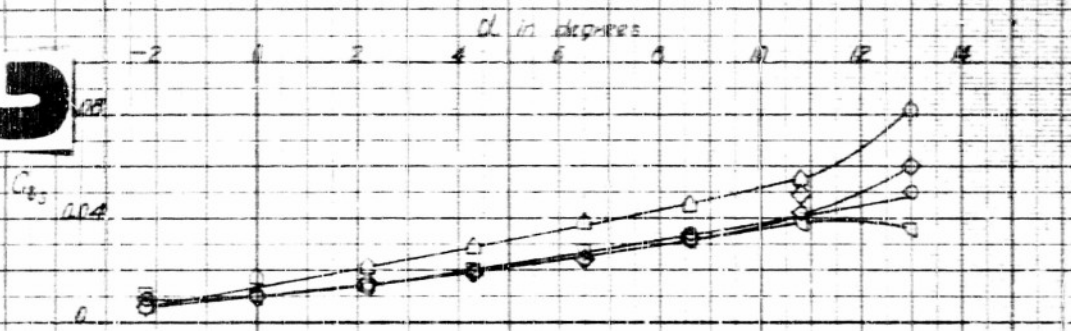
Figure 1 (continued)  
 (b) Continued

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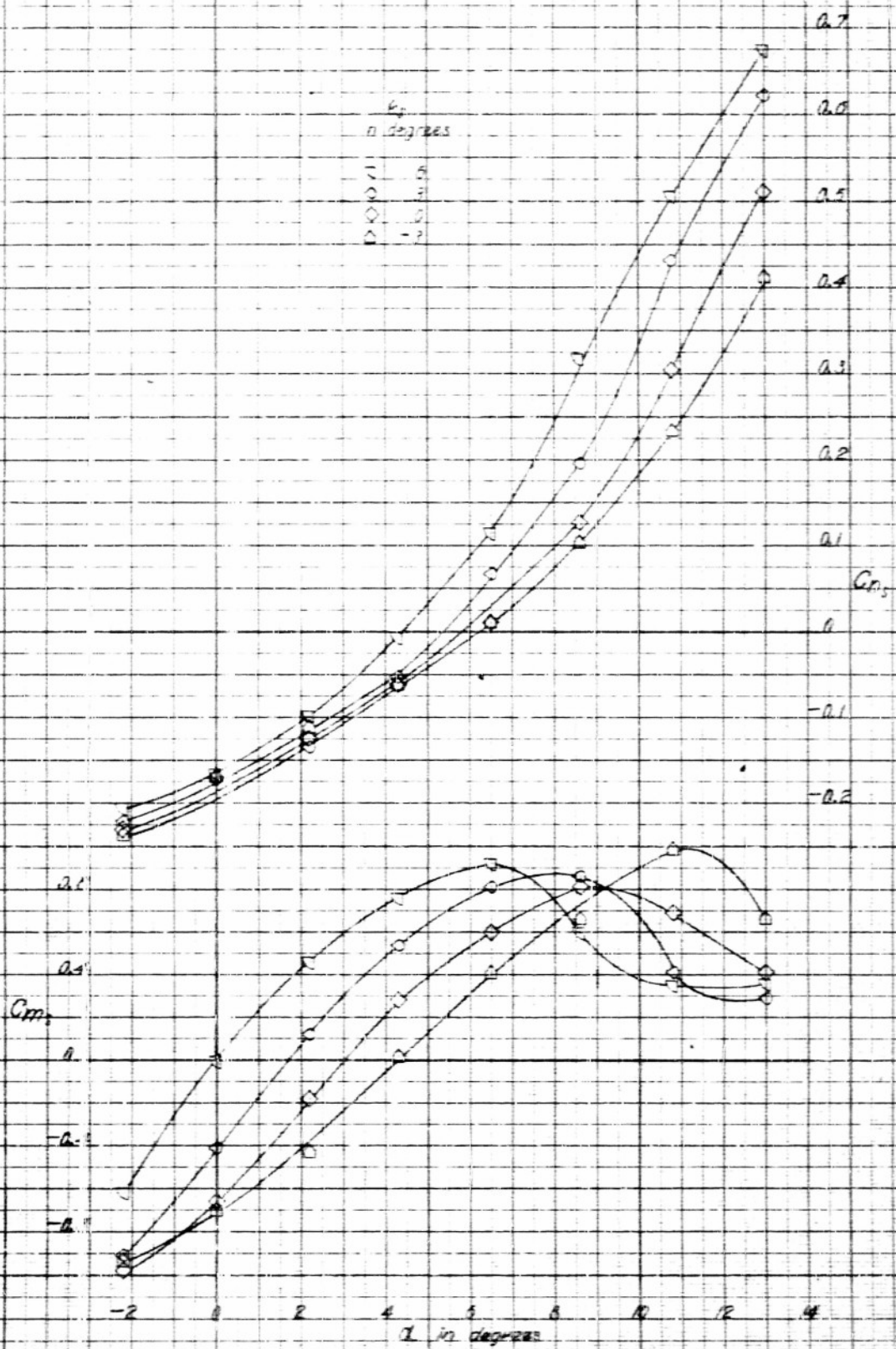


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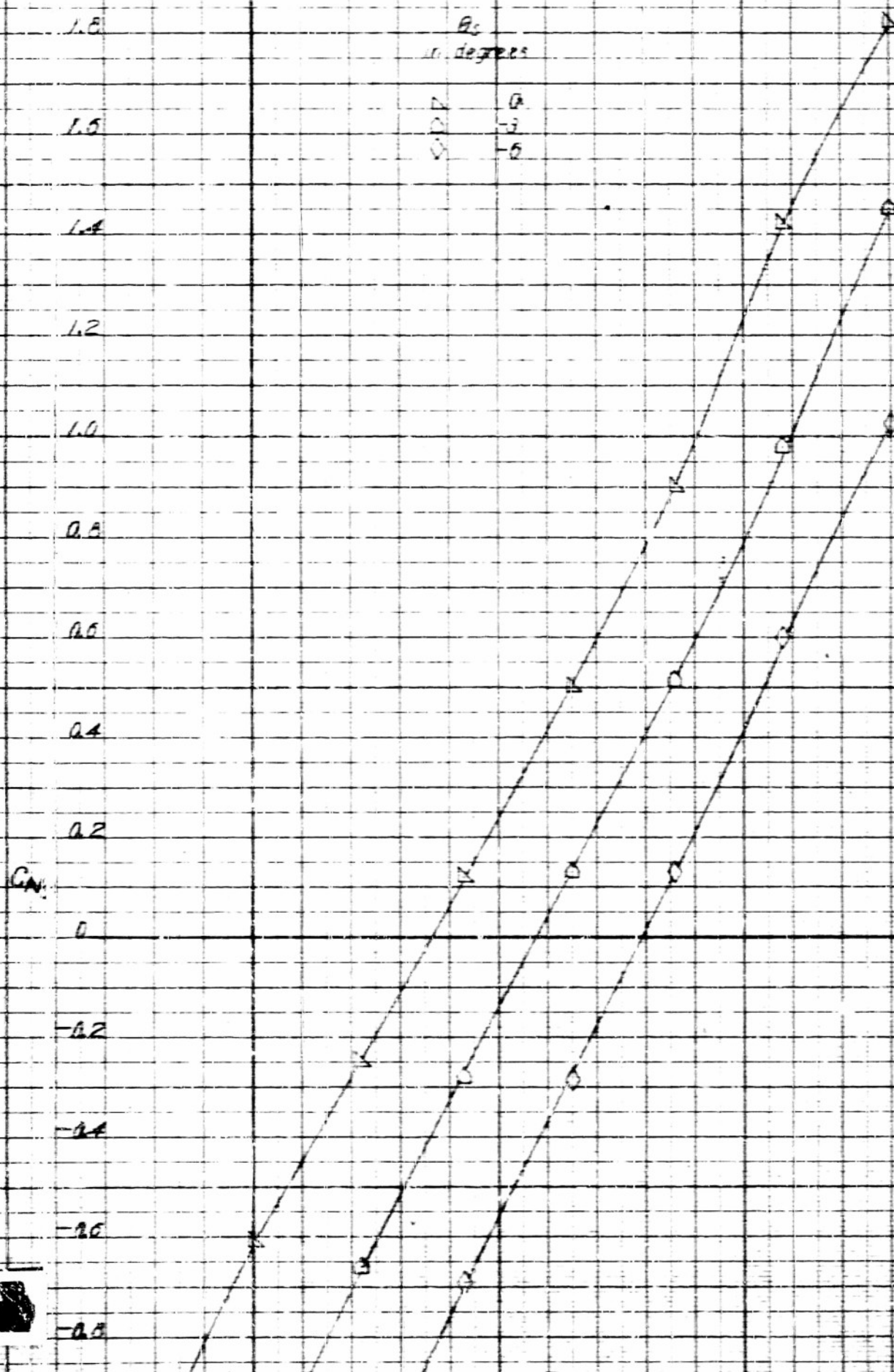
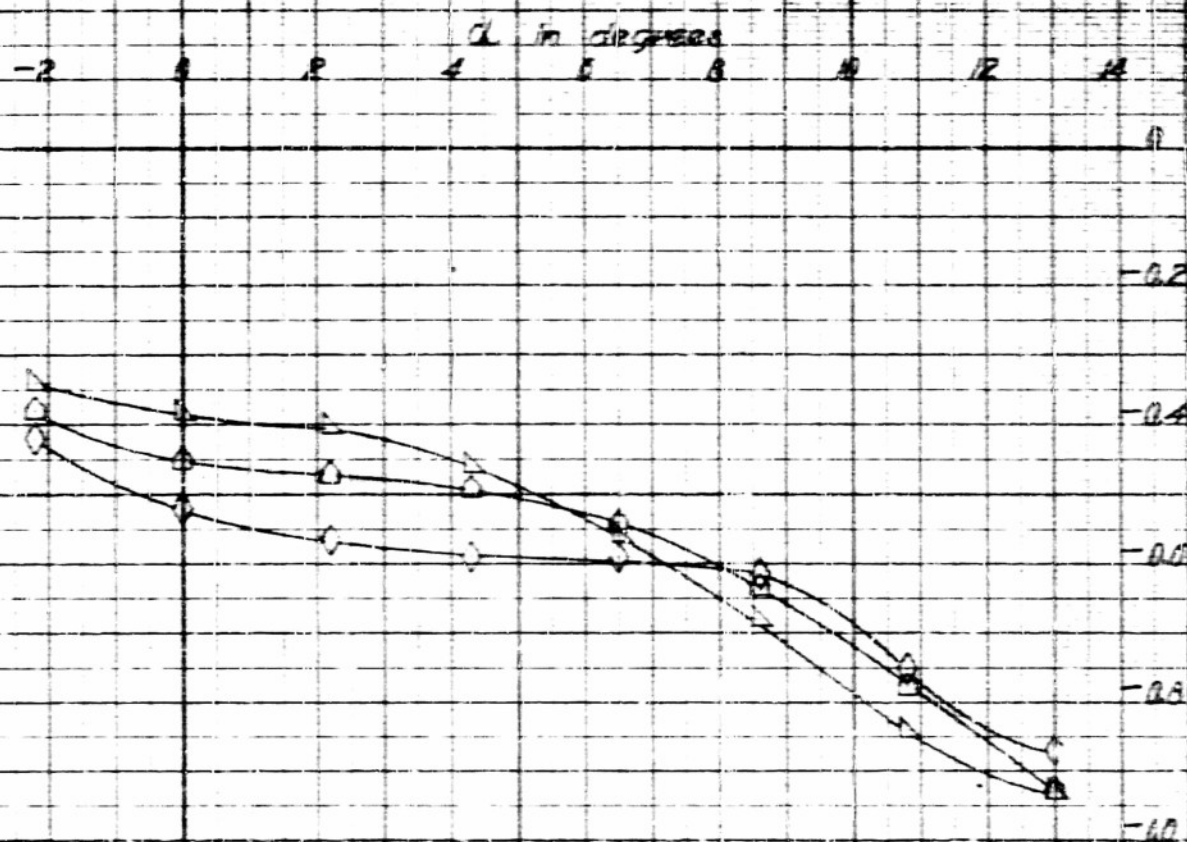
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Figure 16 (continued)  
 (b) Continued



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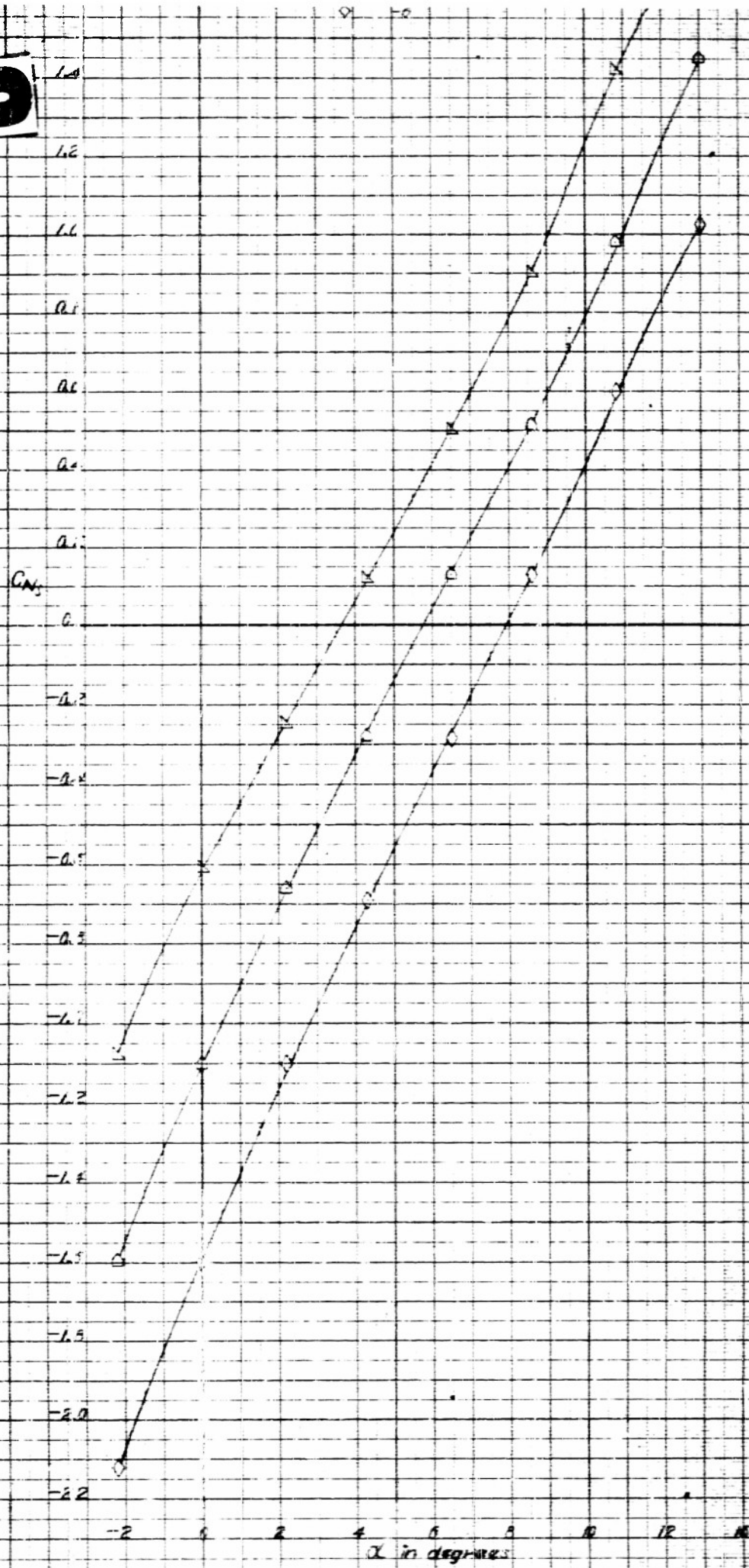


FIGURE 16

Figure 16 (continued)

(f)  $z = 1.02$  inches,  $x = 13.36$  inches,  $\psi_0 = 0^\circ$ ,  $\psi = 1^\circ$ , Pylon 10m

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FIGURE 16 (continued)

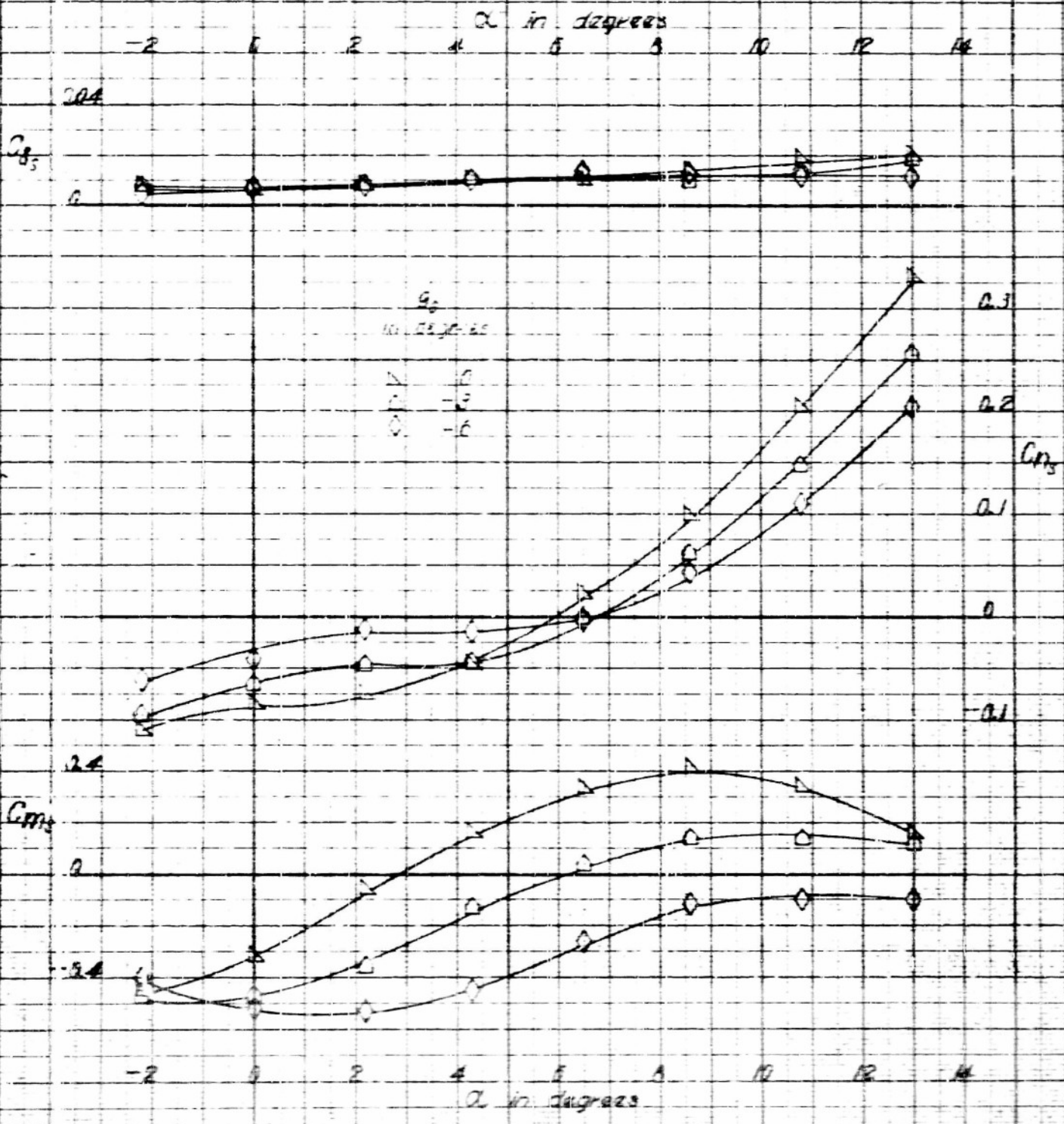


Figure 16 (continued)  
(f) Concluded

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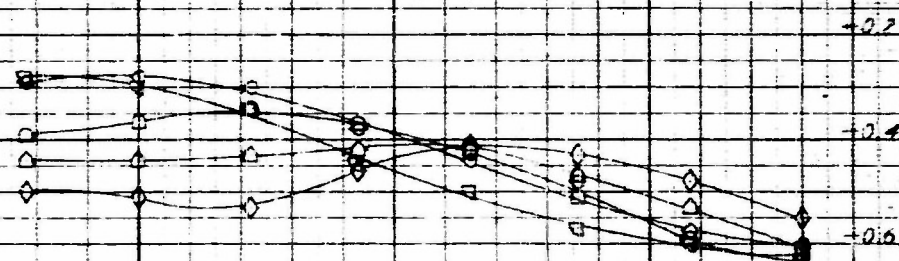


03/24/33

ATLAS

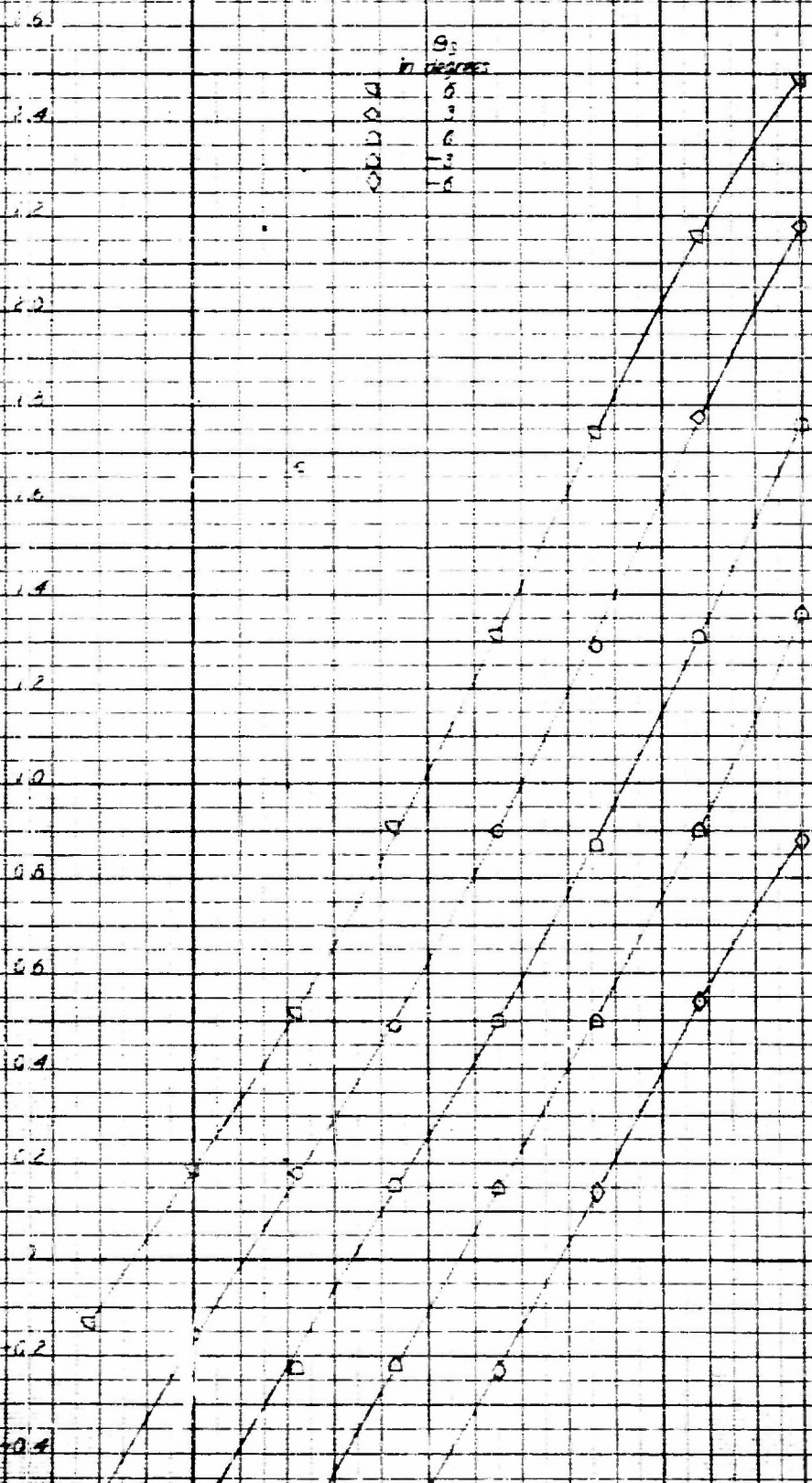
$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14



$\theta_2$  in degrees

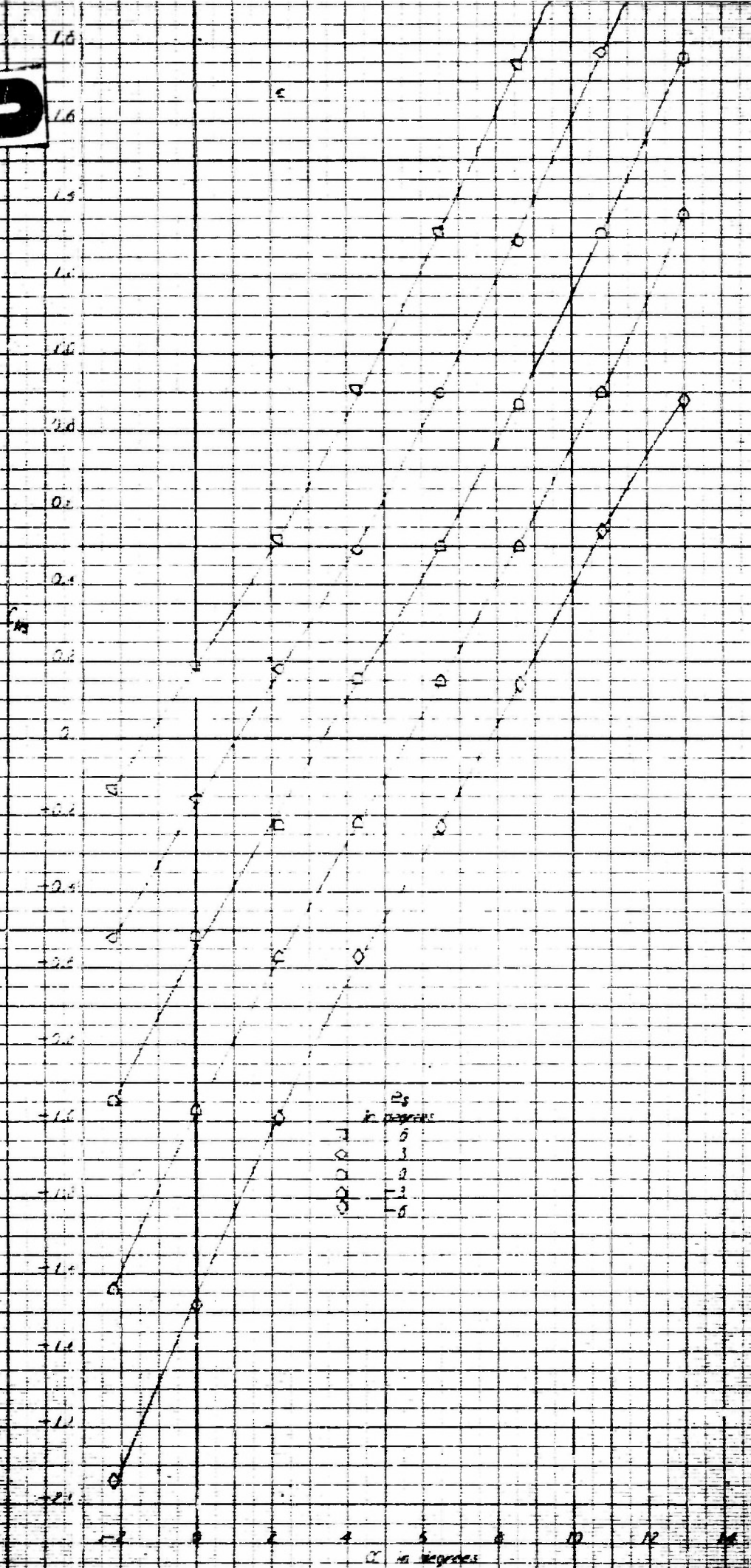
0  
5  
10  
15  
20



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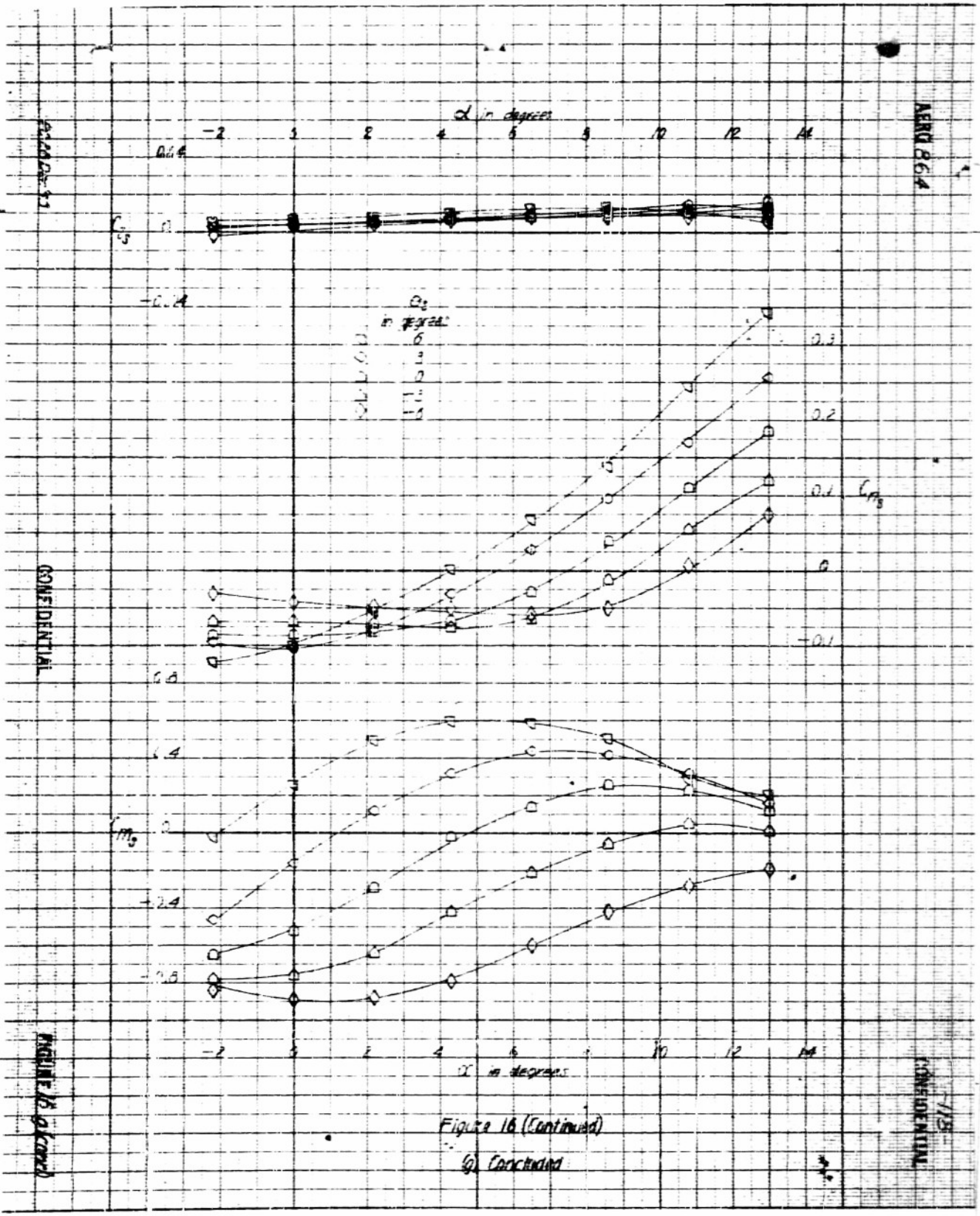
$\beta$  in degrees  
 6  
 5  
 3  
 2  
 1  
 0

Figure B3 (Continued)

$g_1 = 1.02$  Inches,  $x = 16.36$  Inches,  $\psi_1 = 0^\circ$ ,  $\psi_2 = 0^\circ$ ,  $\psi_3 = 0^\circ$

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$\alpha$  in degrees

-1 2 4 6 8 10 12 14

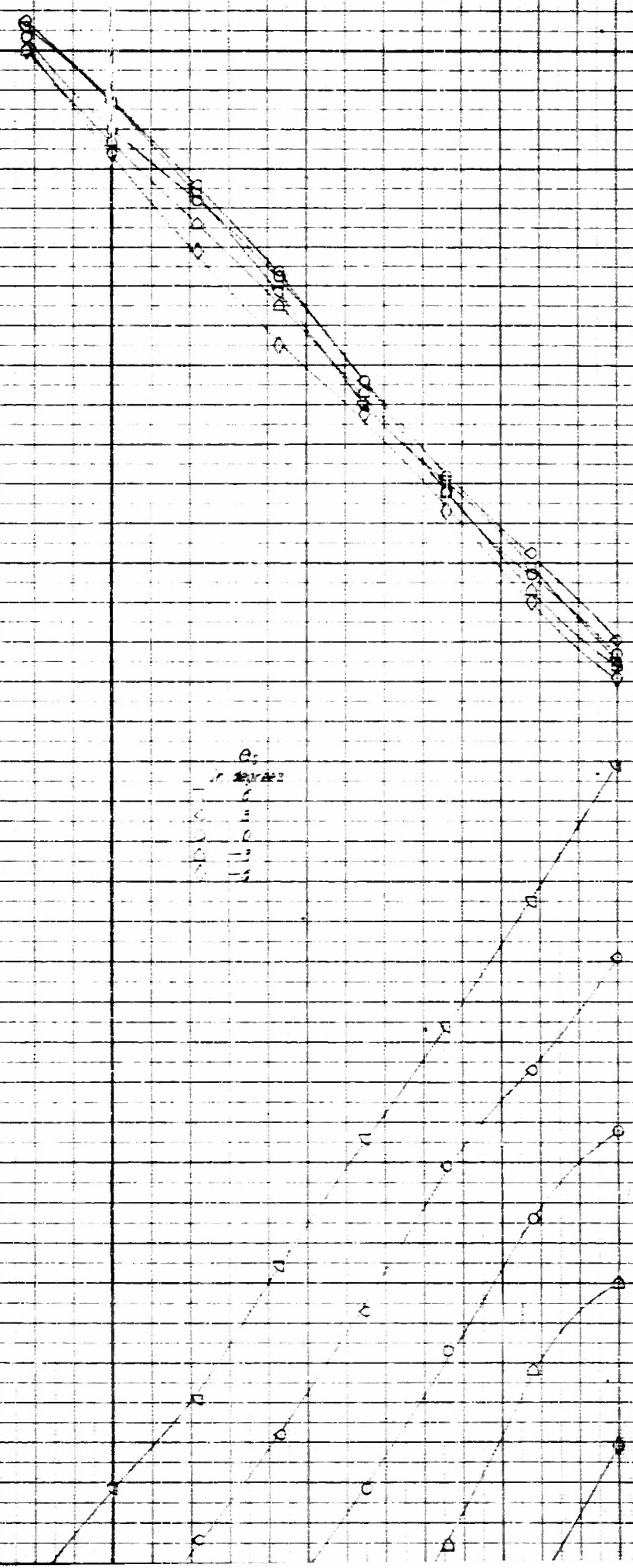
0  
+0.2  
+0.4  
+0.6  
+0.8  
+1.0  
+1.2  
+1.4  
+1.6

$C_y$

2.1  
1.1  
1.1  
1.1  
1.1  
1.1  
0.1  
0.1  
0.1  
0.1  
0.1  
0.1

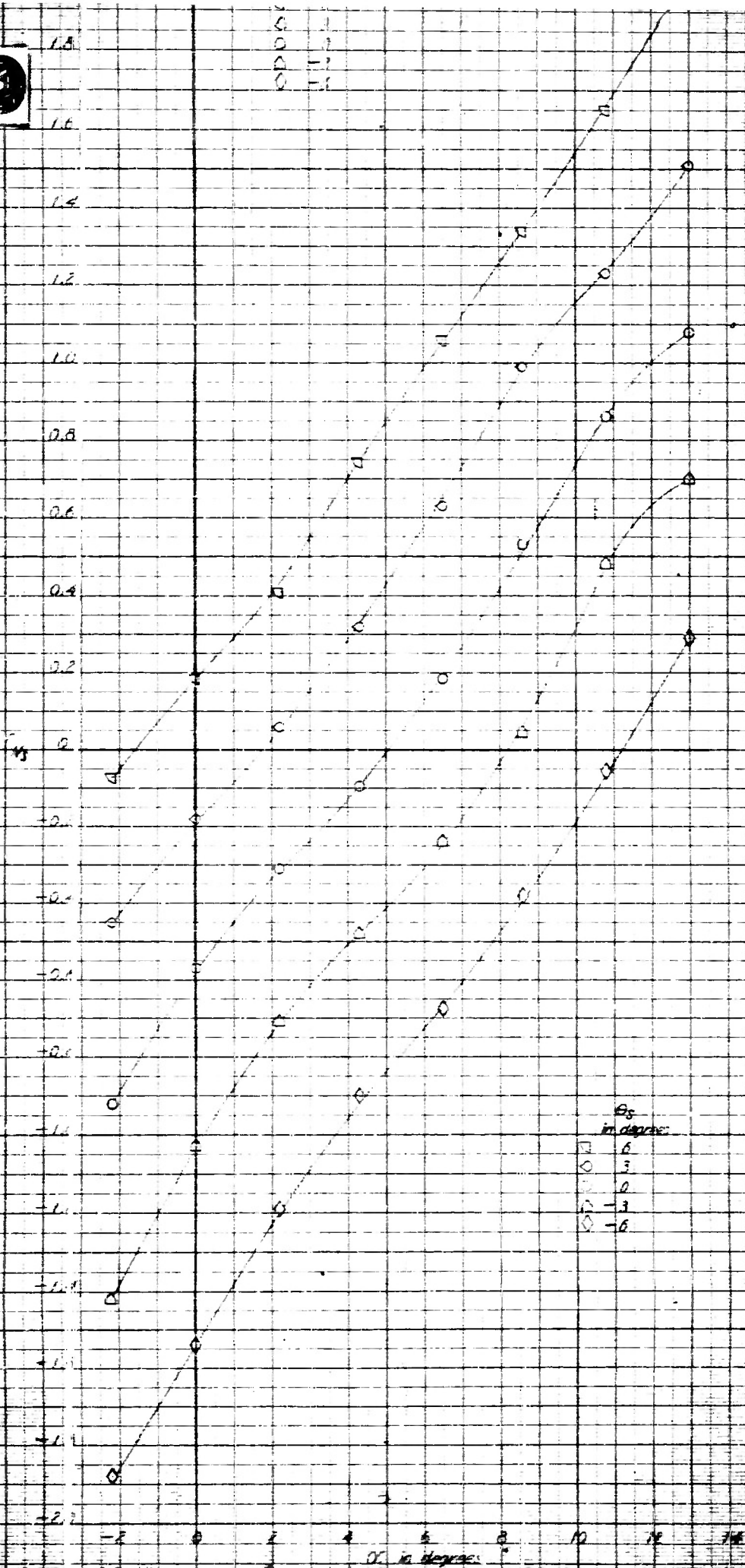
$\alpha_2$   
in degrees  
1  
2  
3  
4  
5  
6

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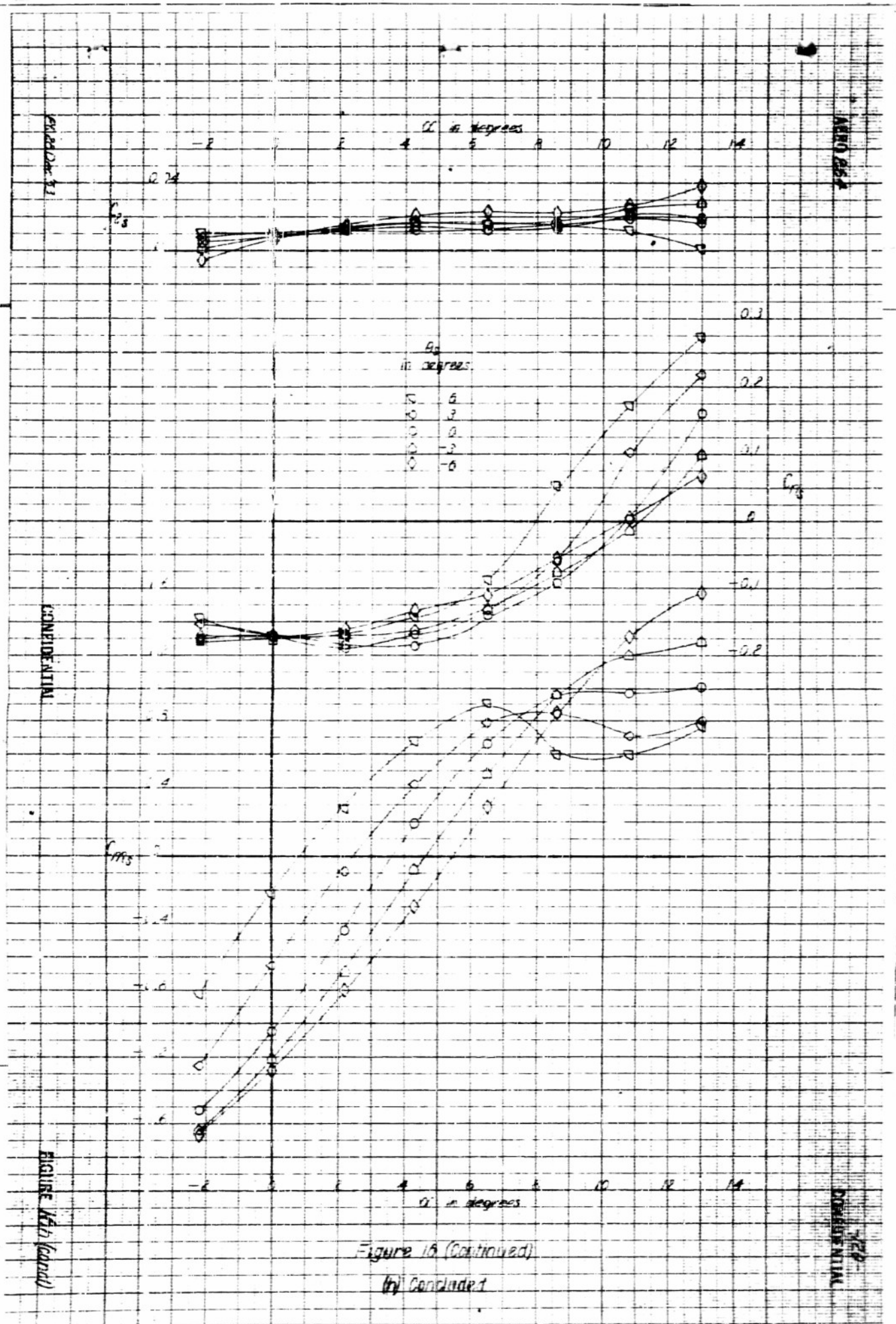
$\theta$  in degrees:  
 6  
 3  
 0  
 -3  
 -6

Figure 16 (Continued)

(a)  $z = 2.04$  inches,  $x = 0$  inch,  $\phi_0 = 0^\circ$ ,  $\psi = 0^\circ$ ,  $R_y = 1.0$

FIGURE 10.0

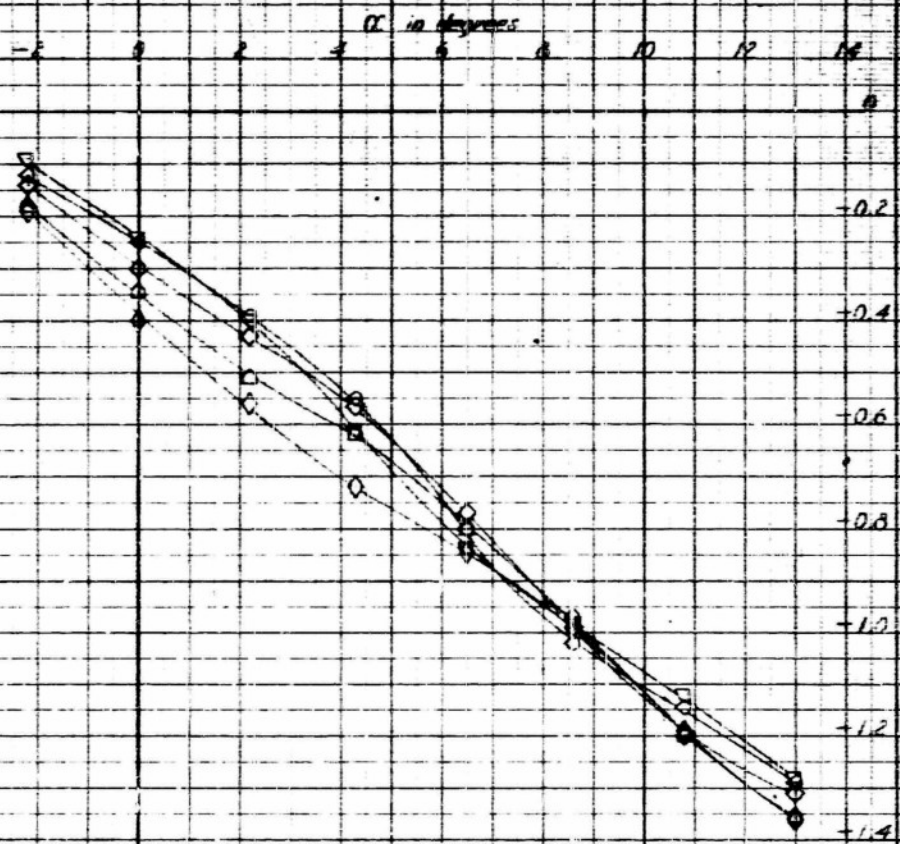
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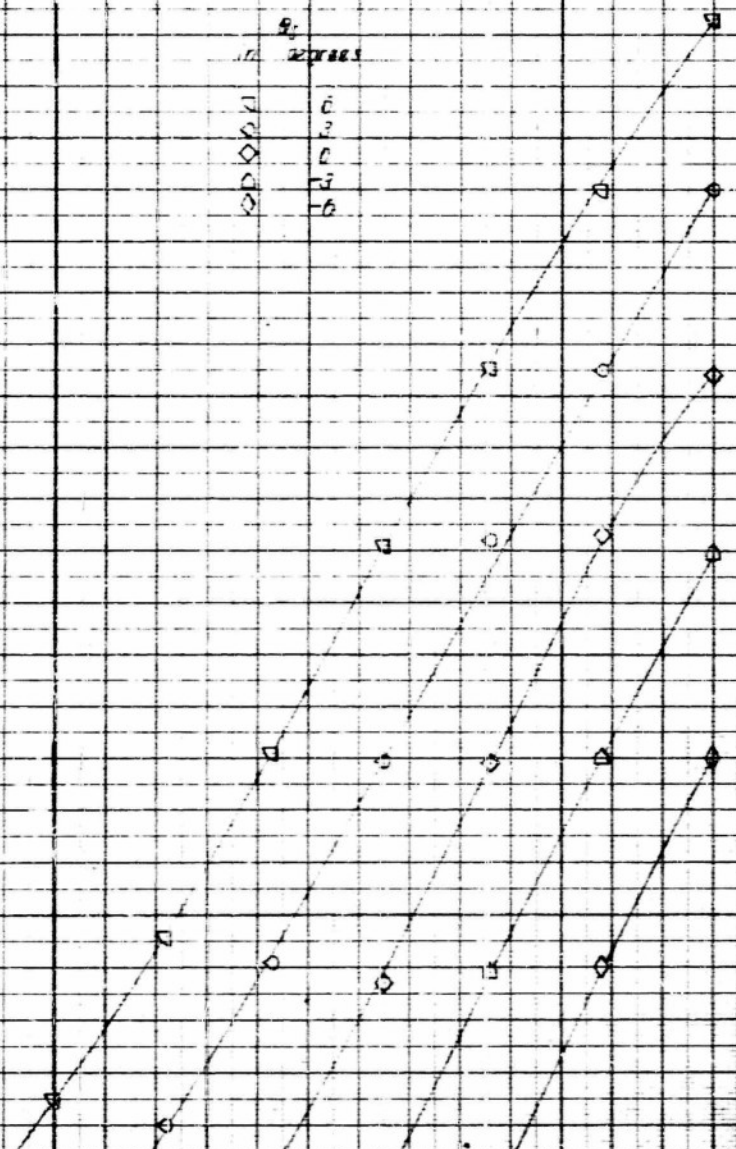
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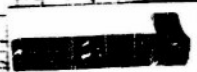
2.3  
2.2  
1.9  
1.8  
1.7  
1.6  
1.5  
1.4  
1.3  
1.2  
1.1  
1.0  
0.9  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2

$\theta$   
in degrees

□	6
◇	2
◇	0
◇	-2
◇	-6



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2

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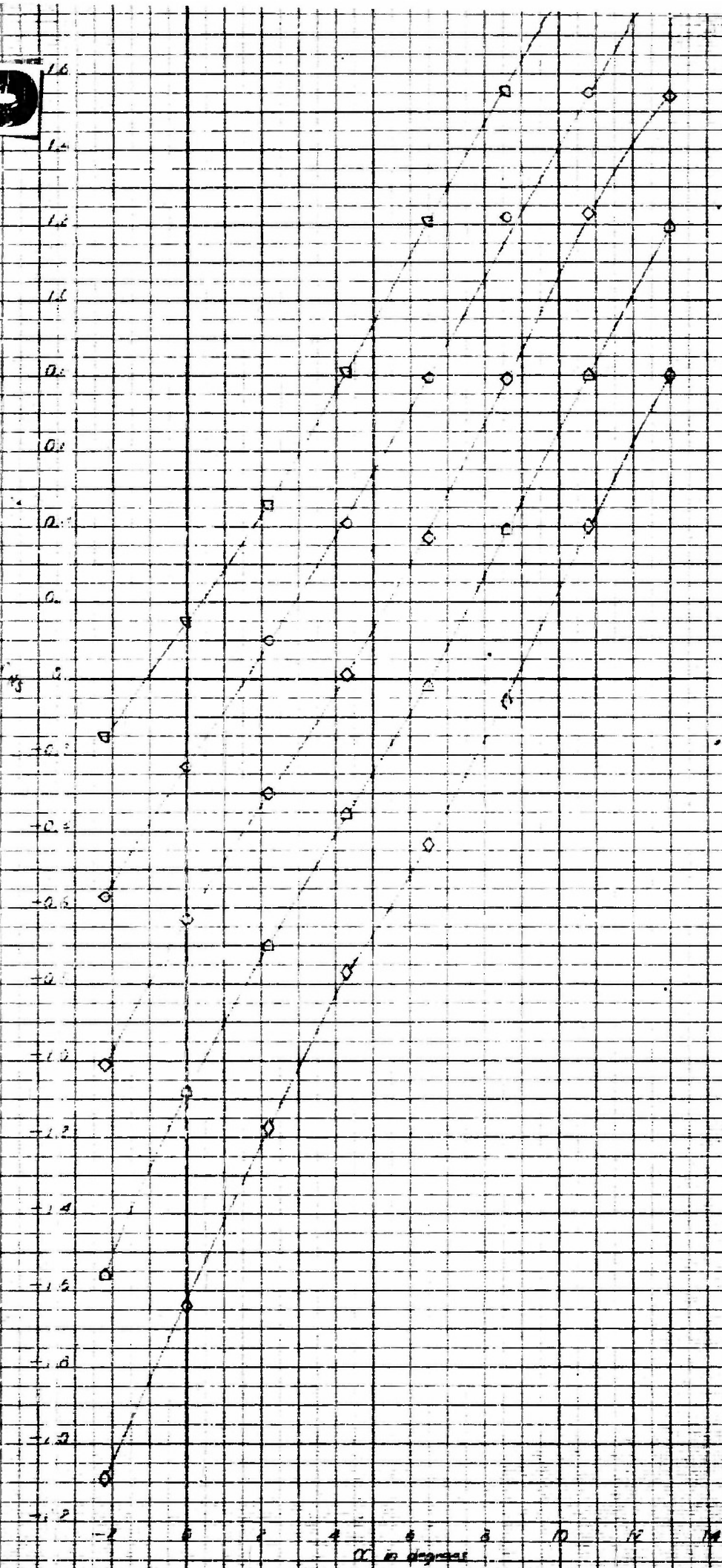


FIGURE 16

Figure 16 (Continued)

$h = 2.0$  inches,  $r = 0.12$  inches,  $\psi_1 = 0$ ,  $\psi_2 = 0$ ,  $\psi_3 = 0$ ,  $\psi_4 = 0$

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FIGURE 10 (continued)

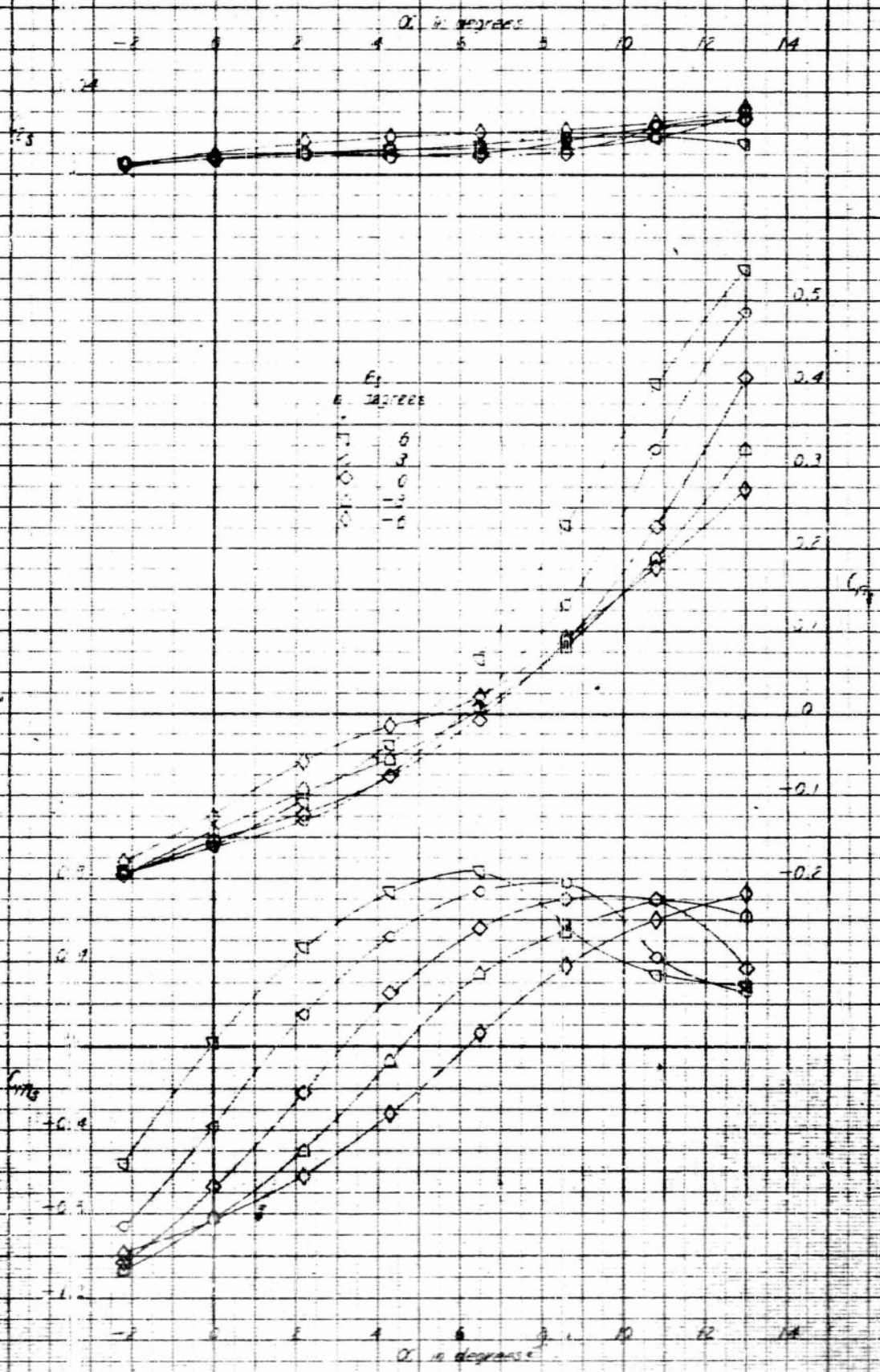


Figure 10 (continued)  
(A) Concluded

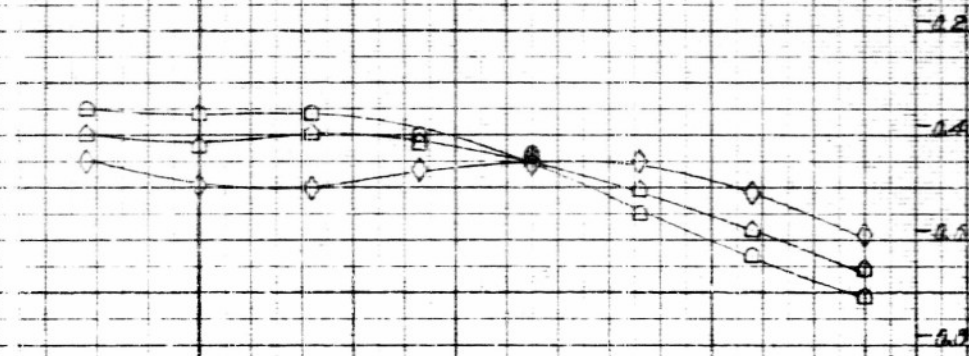
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$\alpha$  in degrees

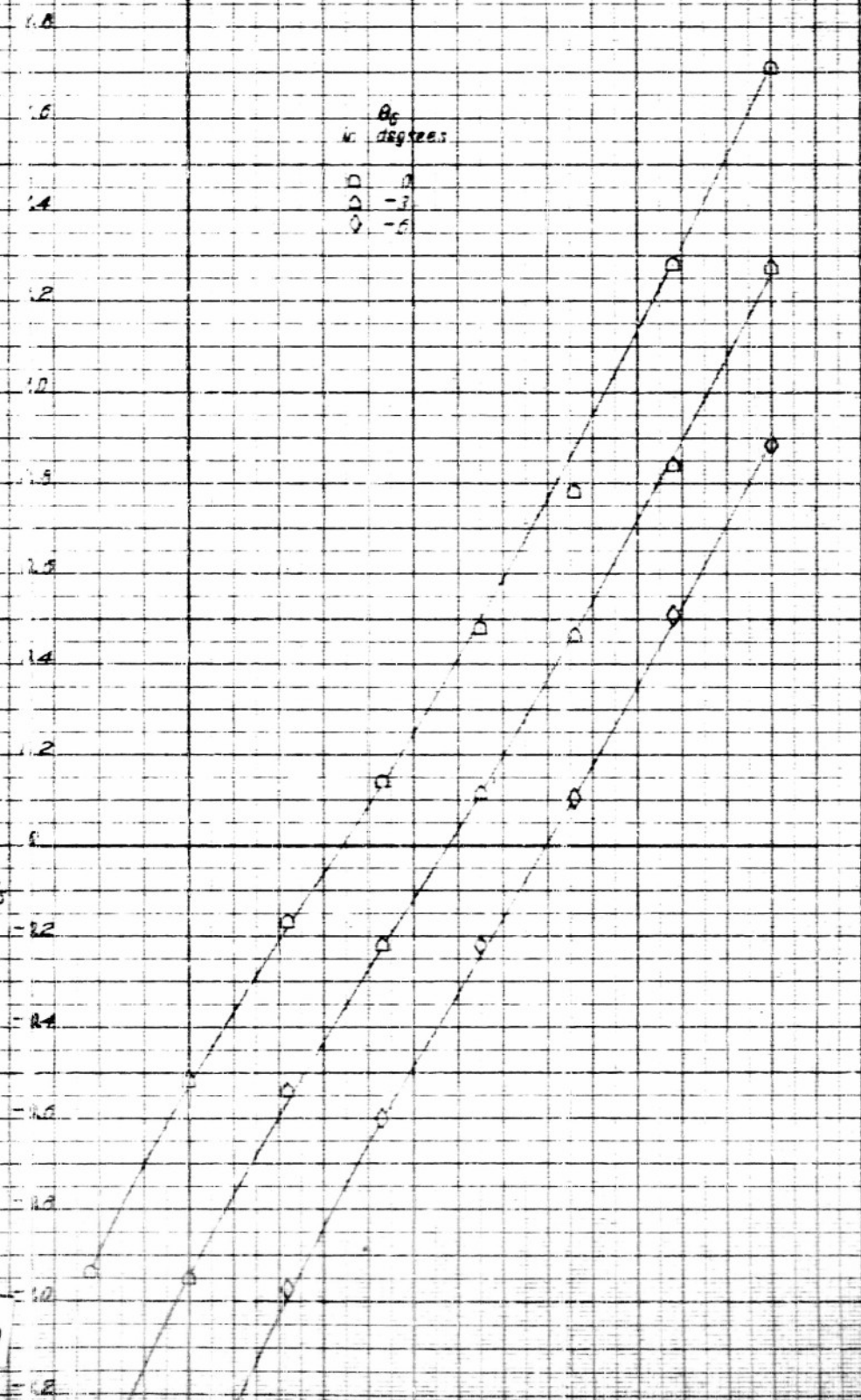
$C_{Y_2}$



$\theta_0$   
in degrees  
 O 0  
 Δ -1  
 ◇ -5

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$C_{A_2}$



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$C_{N_2}$

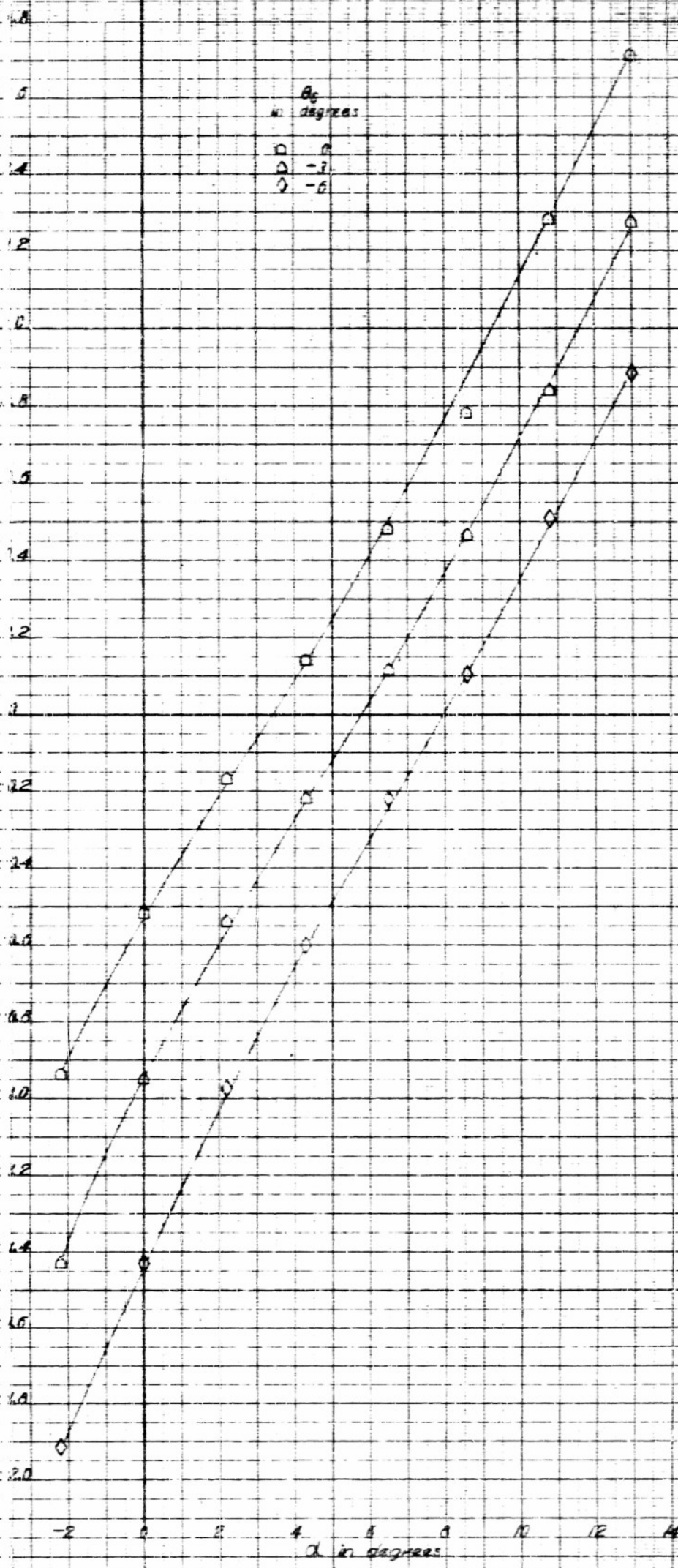


FIGURE 16 (Continued)

(1)  $z = 2.74$  inches,  $x = 19.36$  inches,  $z_0 = 0$ ,  $W = 0$ , Fylon On

FIGURE 16

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FIGURE 16 (Contd.)

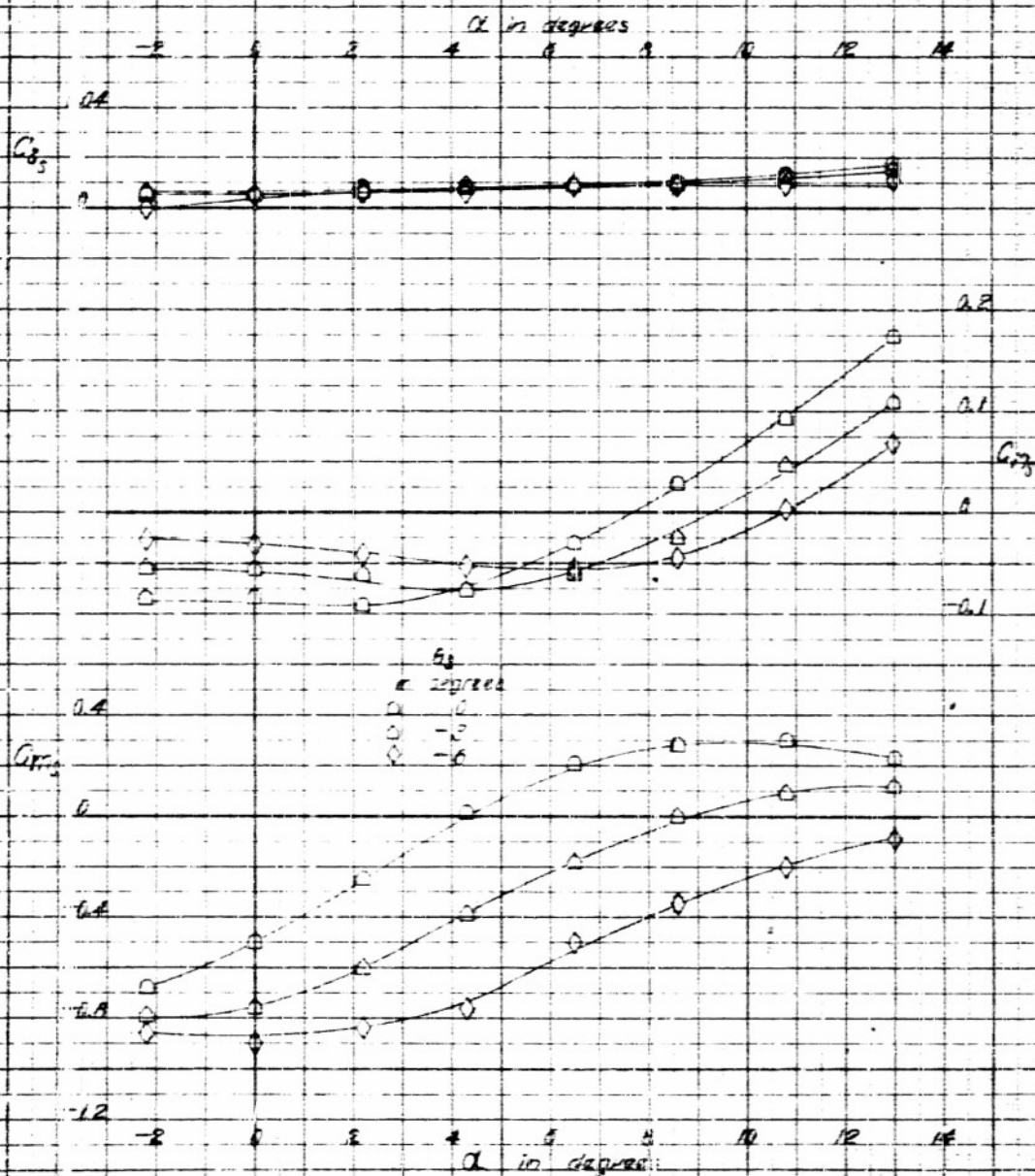


Figure 16 (Continued)

(g) Continued

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CC in Degrees

-2 0 2 4 6 8 10 12 14

-0.2

-0.4

-0.6  $C_{y_0}$

-0.8

-1.0

-1.2

$\delta_1$   
in degrees

0  
0  
-0

8

6

4

2

2

0

-0.2

-0.4

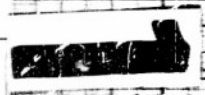
-0.6

-0.8

-1.0

-1.2

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2

$\theta$  in degrees

0 0  
0 0  
0 0

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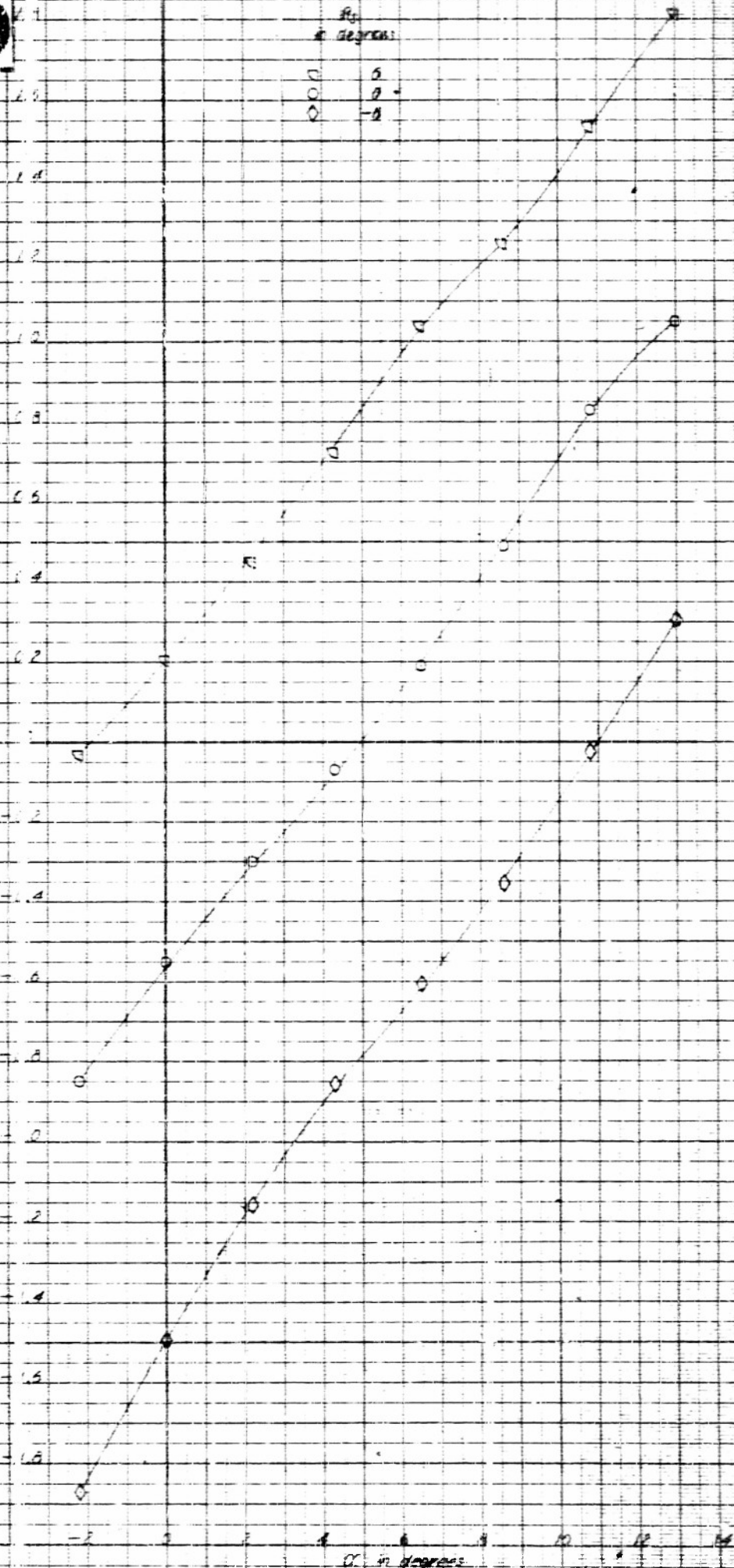


Figure 10

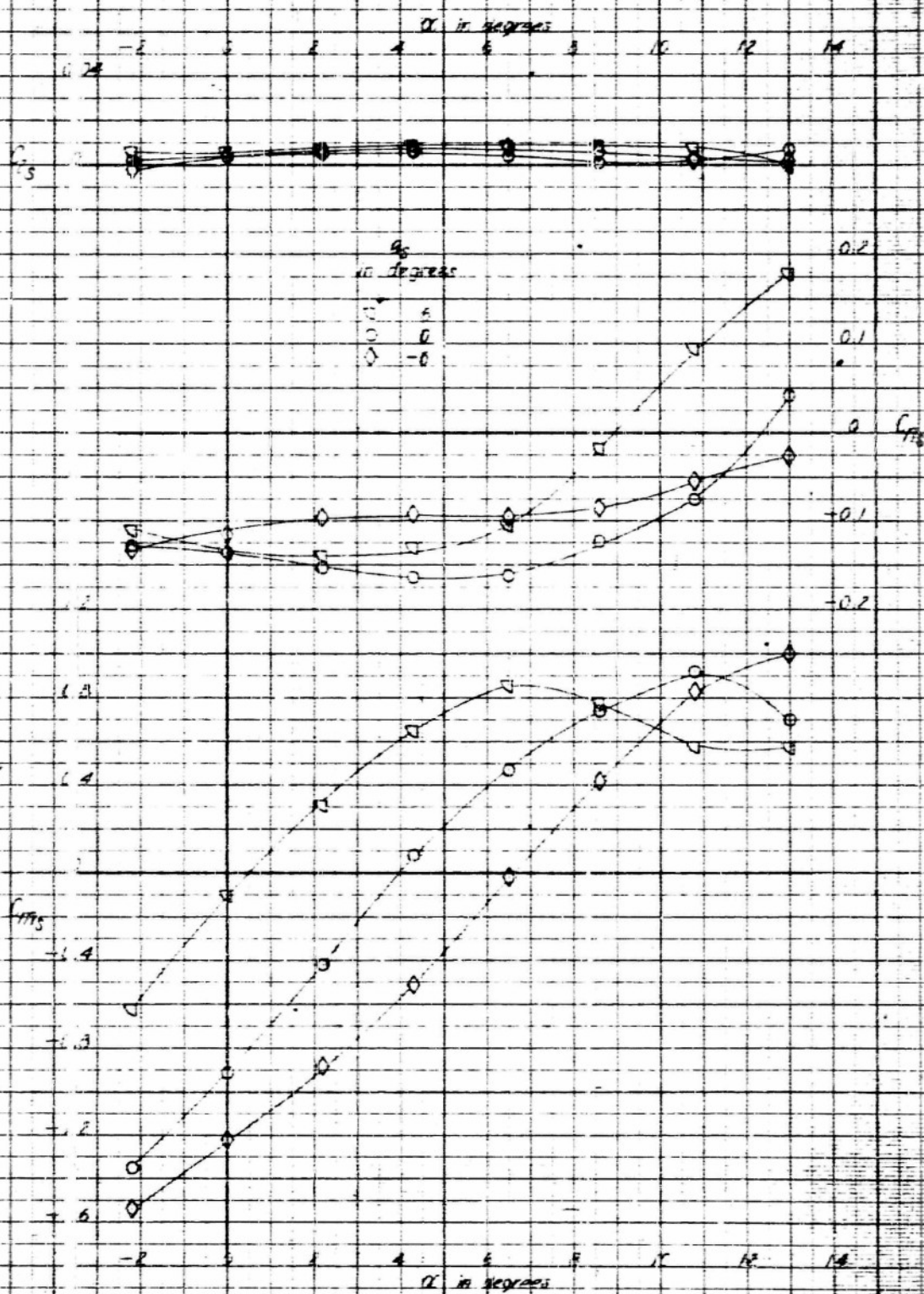
$\theta = 1.25$  inches,  $x = 0.1$  inch,  $W_1 = 0$ ,  $W_2 = 0$ , Pylon On

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FIGURE 15 (Continued)

Figure 16 (Continued)  
- (b) Continued

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SECRET

DE IN DEGREE

2 4 6 8 10 12 14

0.6

0.4

0.2

0

-0.2

-0.4

-0.6

-0.8

-1.0

-1.2

-1.4

-1.6

-1.8

-2.0

-2.2

DE IN DEGREE

Δ	2
○	1
◇	-2

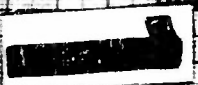
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1.2

0.8

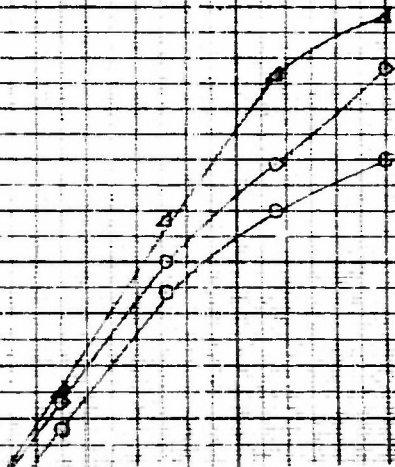
0.4

0.2



0.2

0.2



# 2

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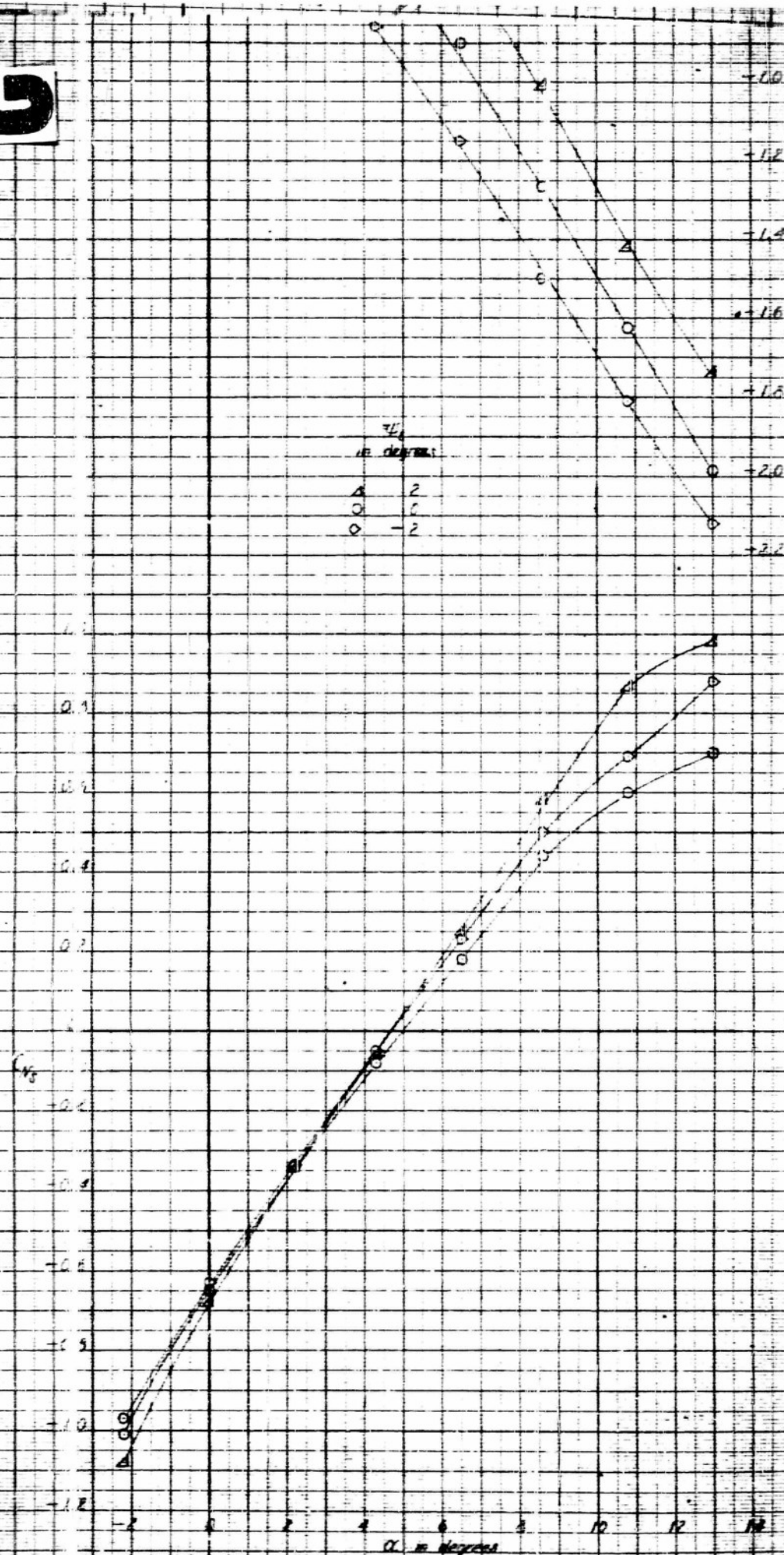


Figure 17 - Aerodynamic Characteristics of a 0.17-Scale Model XAAM-N-4 Orion Missile Due to Missile Yaw in the Proximity of a 0.179-Scale Model F4D-1 Airplane at the Outboard Station  
 (a)  $z = 0.1$  inch,  $x = 0.1$  inch,  $\beta_0 = 0^\circ$ ,  $\gamma_0 = 6^\circ$ , Flykes On

FIGURE 17/12

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$\alpha$  in degrees

$C_{\theta_1}$

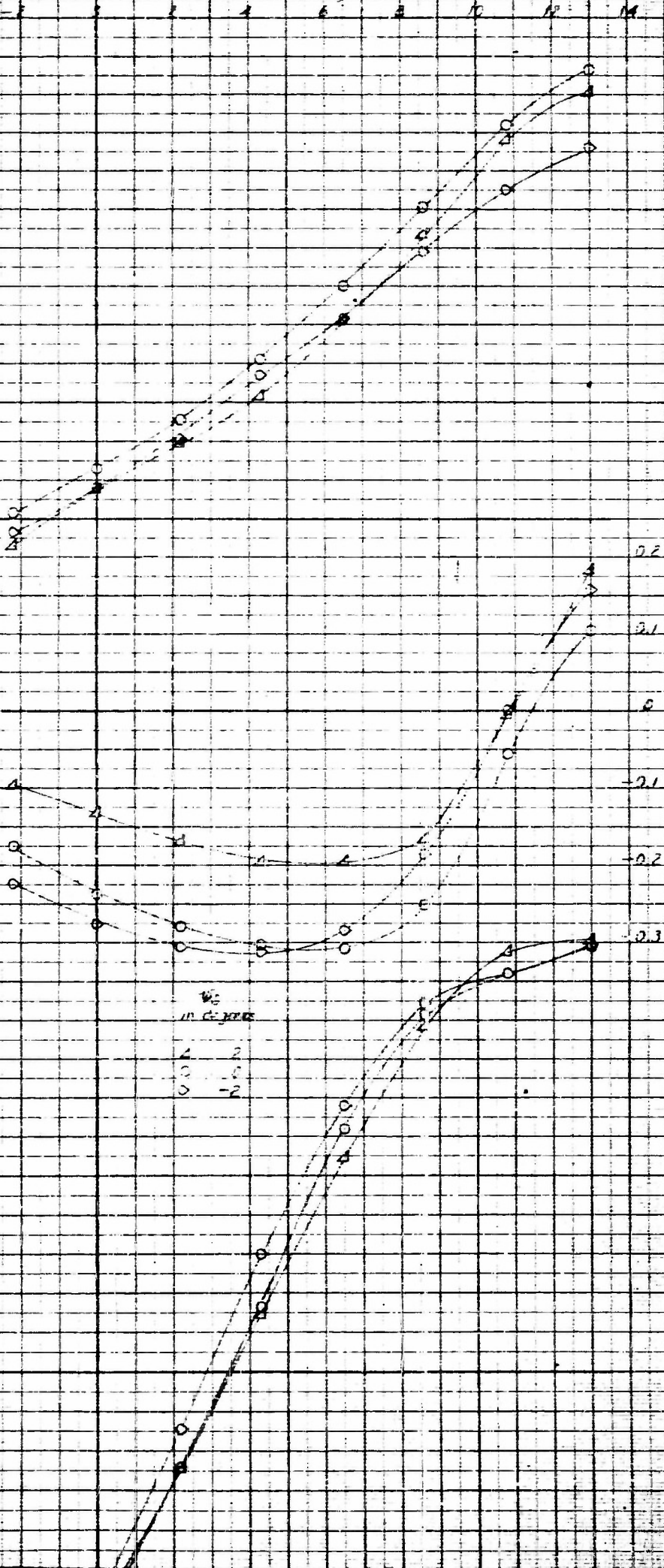
$C_{\theta_2}$

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$\alpha$  in degrees

$C_{\theta_3}$

$\alpha$  2  
 $\alpha$  0  
 $\alpha$  -2





2

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ENSURE 17a (cont'd)

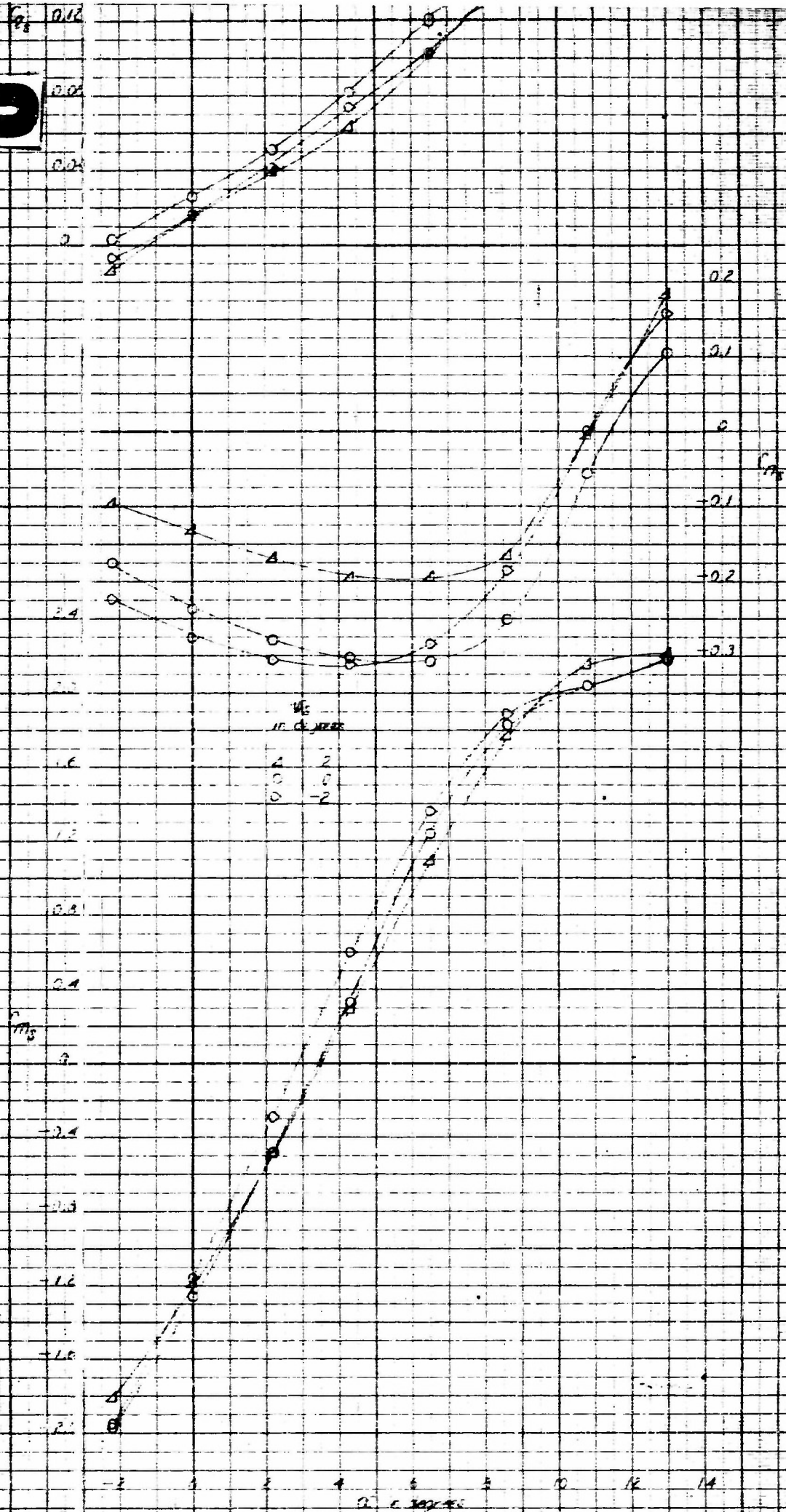


Figure 17 (Continued)

b) Concluded

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$\alpha$  in degrees

APPROX

-2 0 2 4 6 8 10 12 14

0.2

0

-0.2

-0.4

-0.6

-0.8

-1.0

-1.2

-1.4

2.0

1.8

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

0

$\beta$   
0.00722

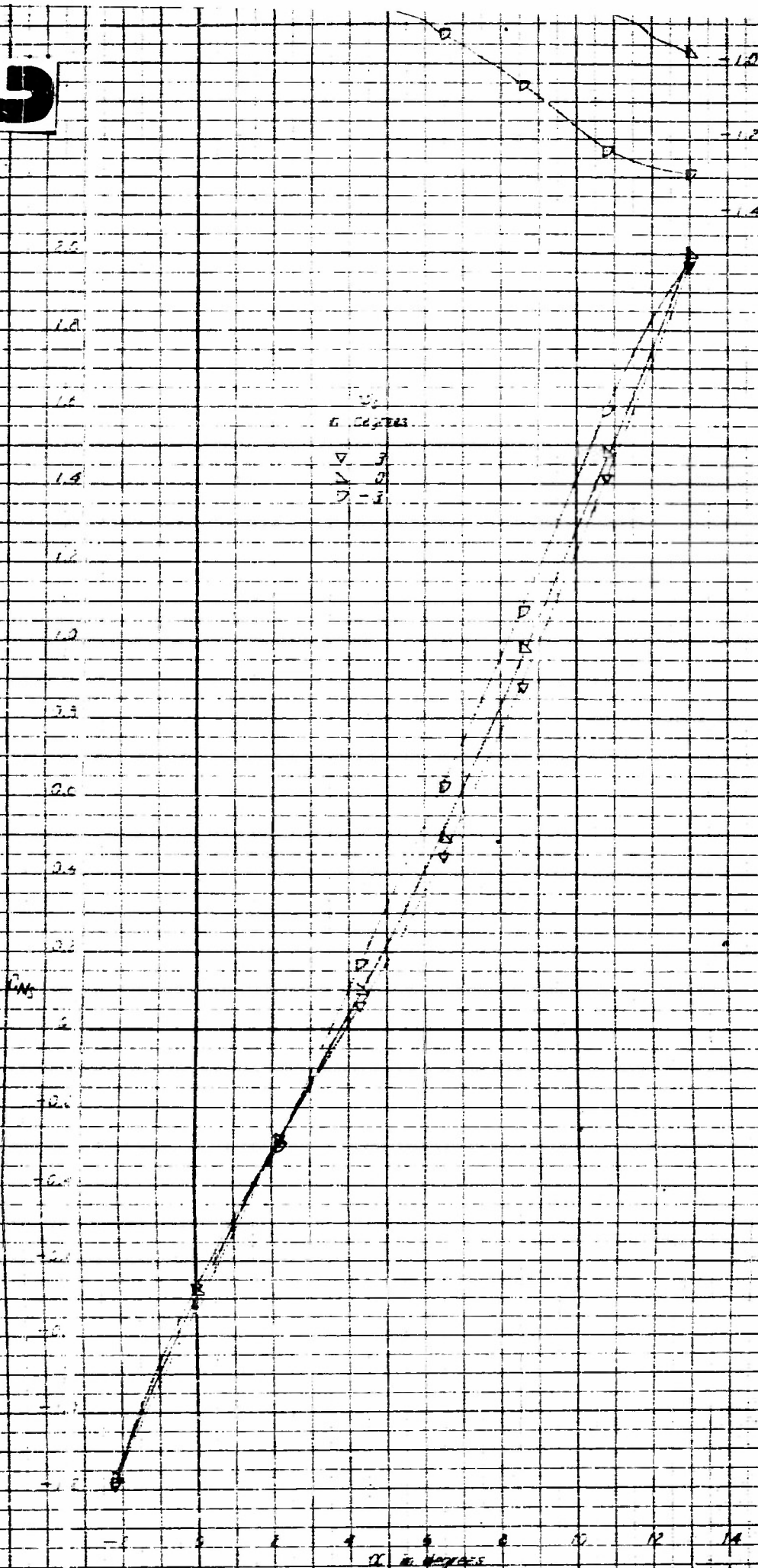
$\gamma$  3  
 $\delta$  1  
 $\epsilon$  -1

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1



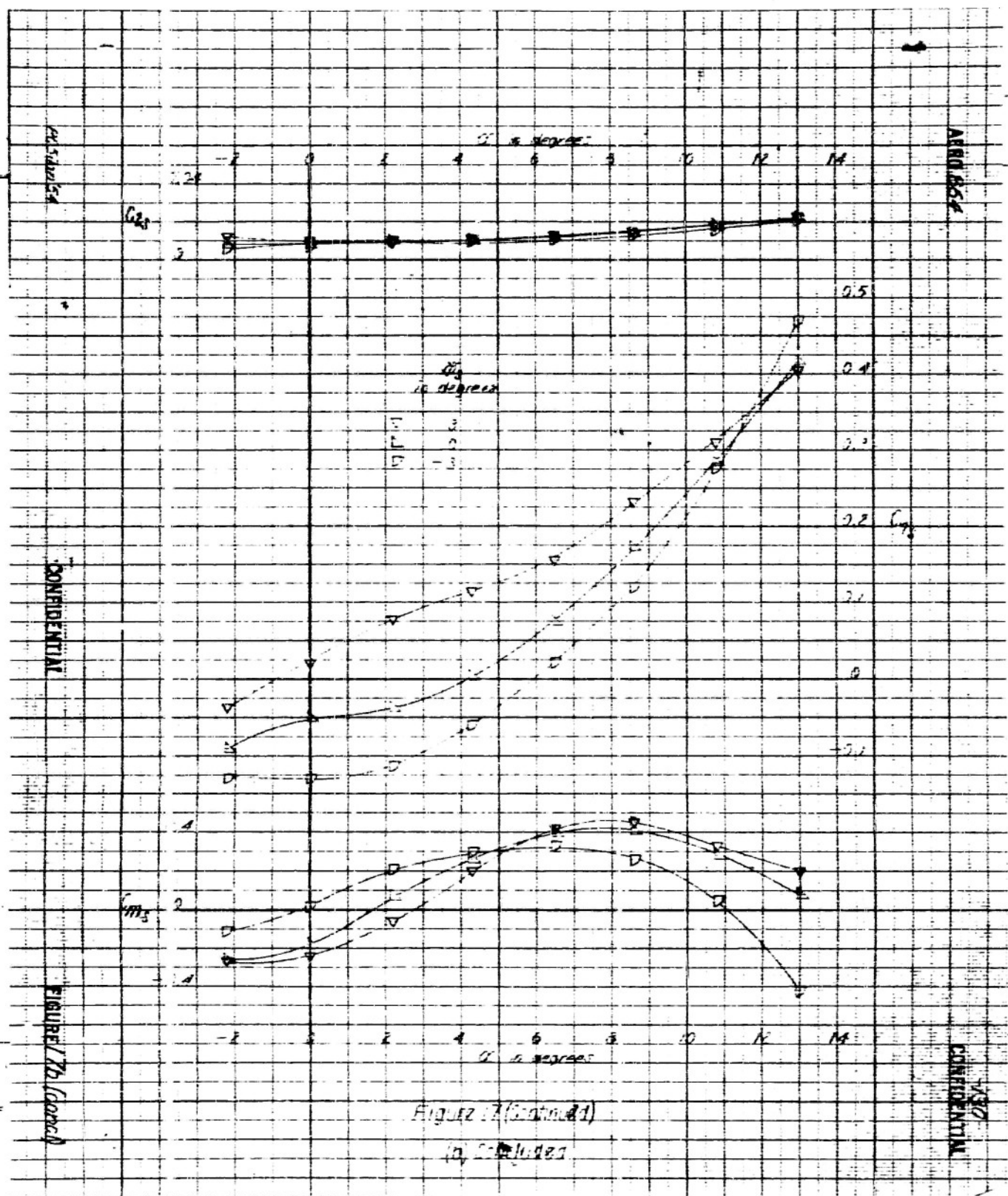
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**FIGURE 2**

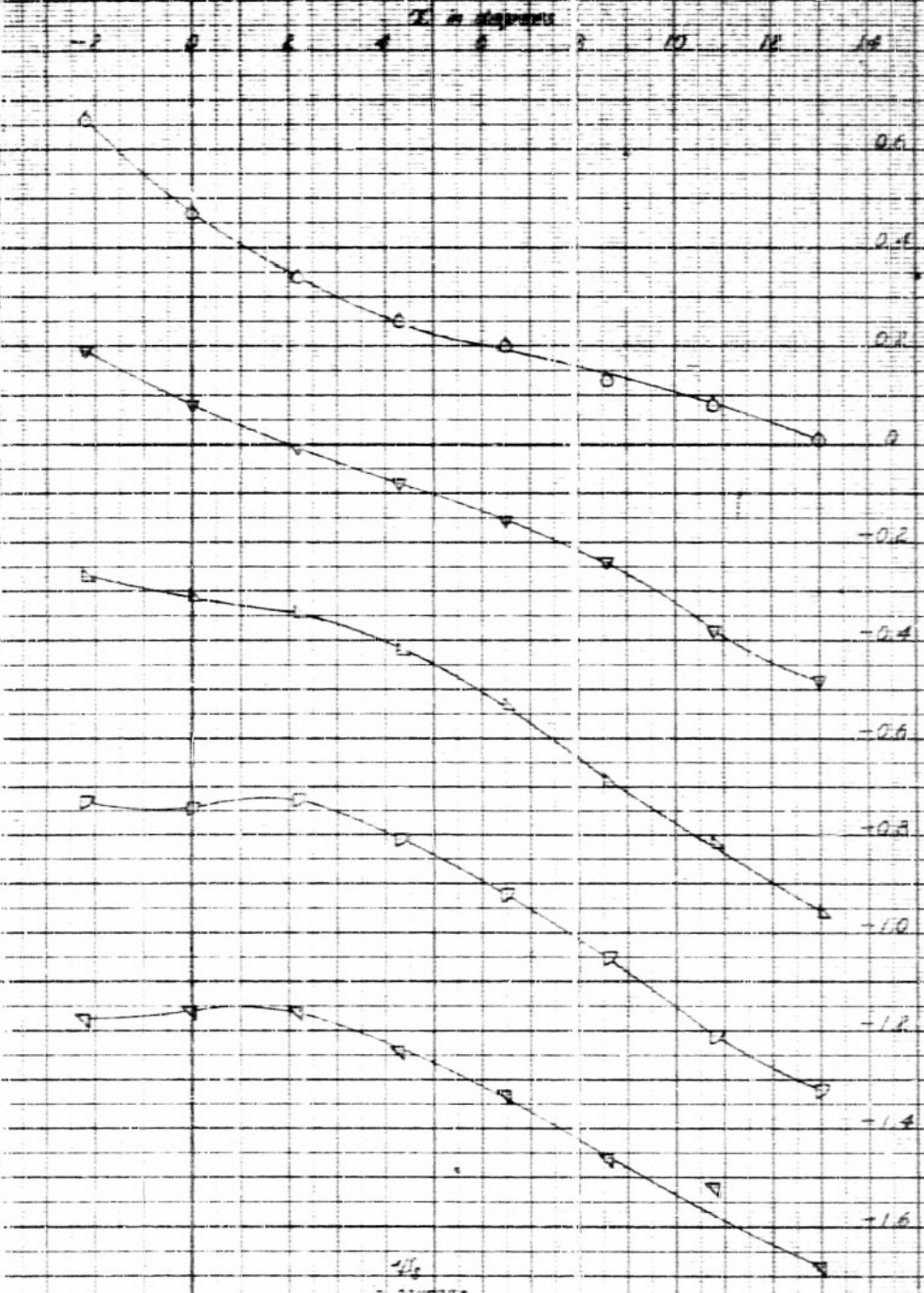
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2.2  
2.0  
1.8  
1.6  
1.4  
1.2  
1.0

$\frac{1}{T}$   
in degrees

0	5
1	3
2	0
3	-3
4	-6





2

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$\alpha$  in degrees  
6  
3  
0  
-3  
-6

$r_{N3}$

$\alpha$  in degrees

Figure 17 (Continued)

$b_1 = 0.1$  inch,  $b_2 = 1.320$  inches,  $A_1 = 0$ ,  $N = 0$ , Pylon 07

FIGURE 17



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FIGURE 7C (Contd.)

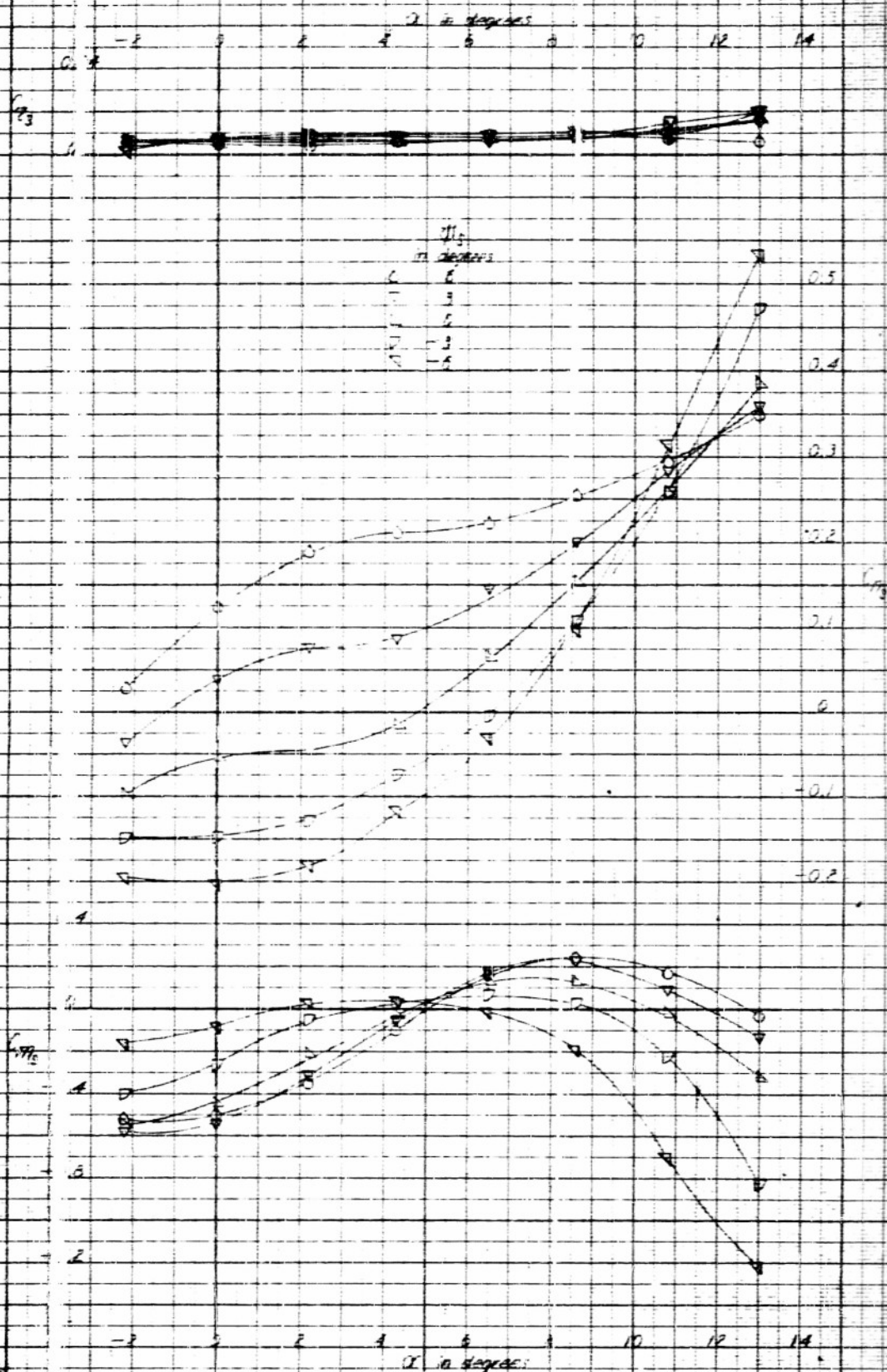
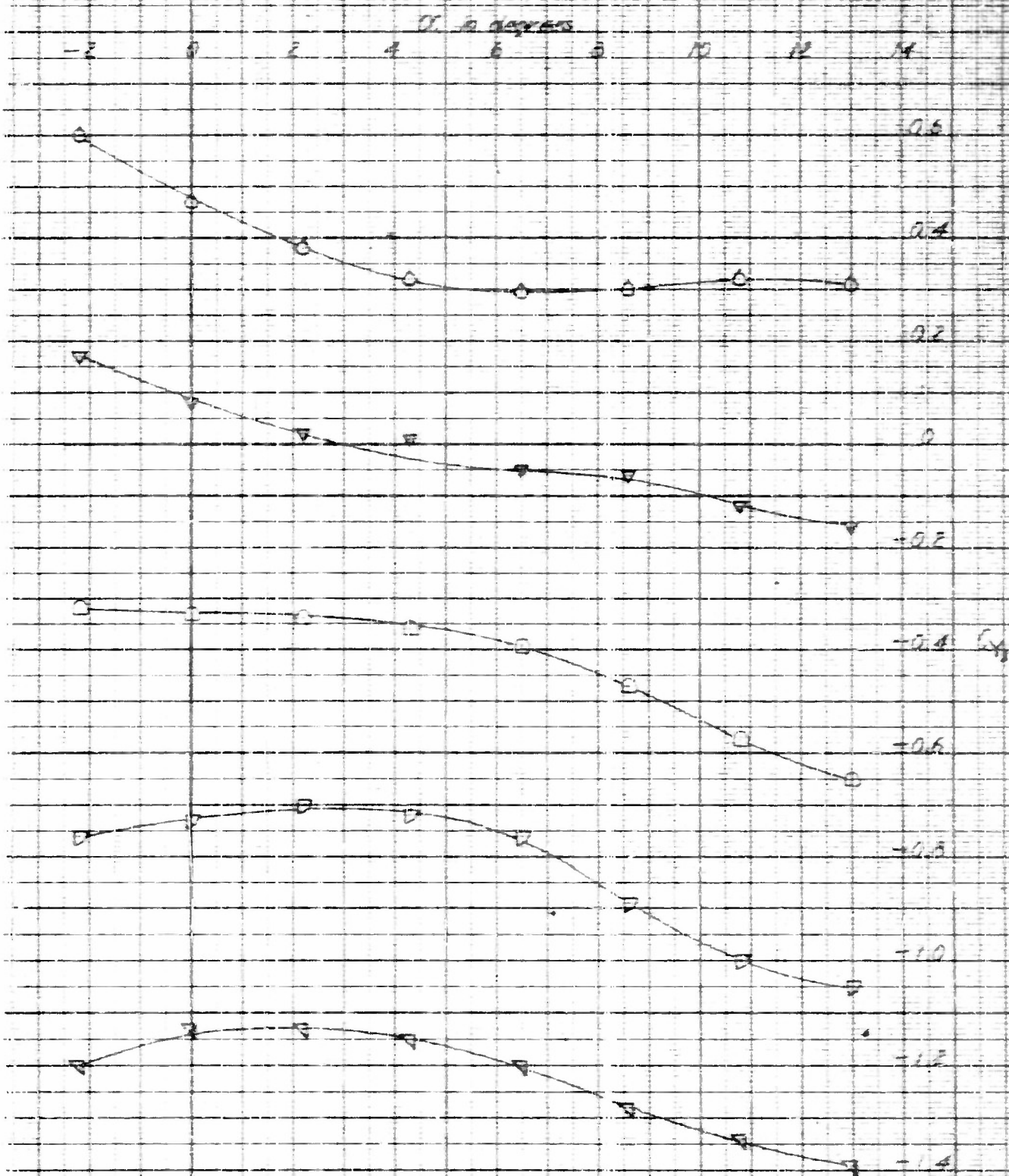


Figure 7C (Continued)

(C) Continued

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ASSEMBLY



$\alpha$ , in degrees

○	5
△	3
□	0
▽	-3
◇	-5

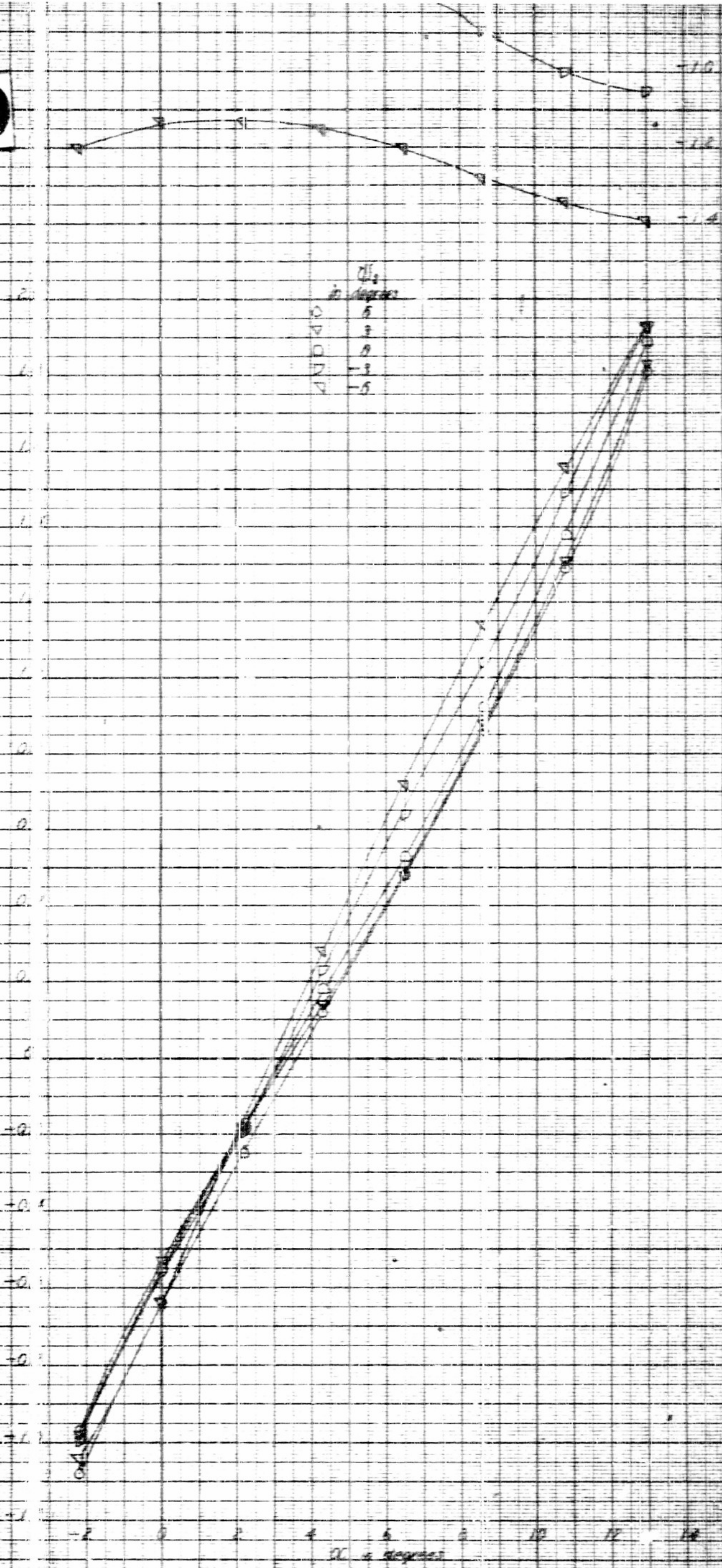
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1



2

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$C_m$   
in degrees  
1.0  
1.2  
1.4  
1.6  
1.8  
2.0

Figure 17 (continued)

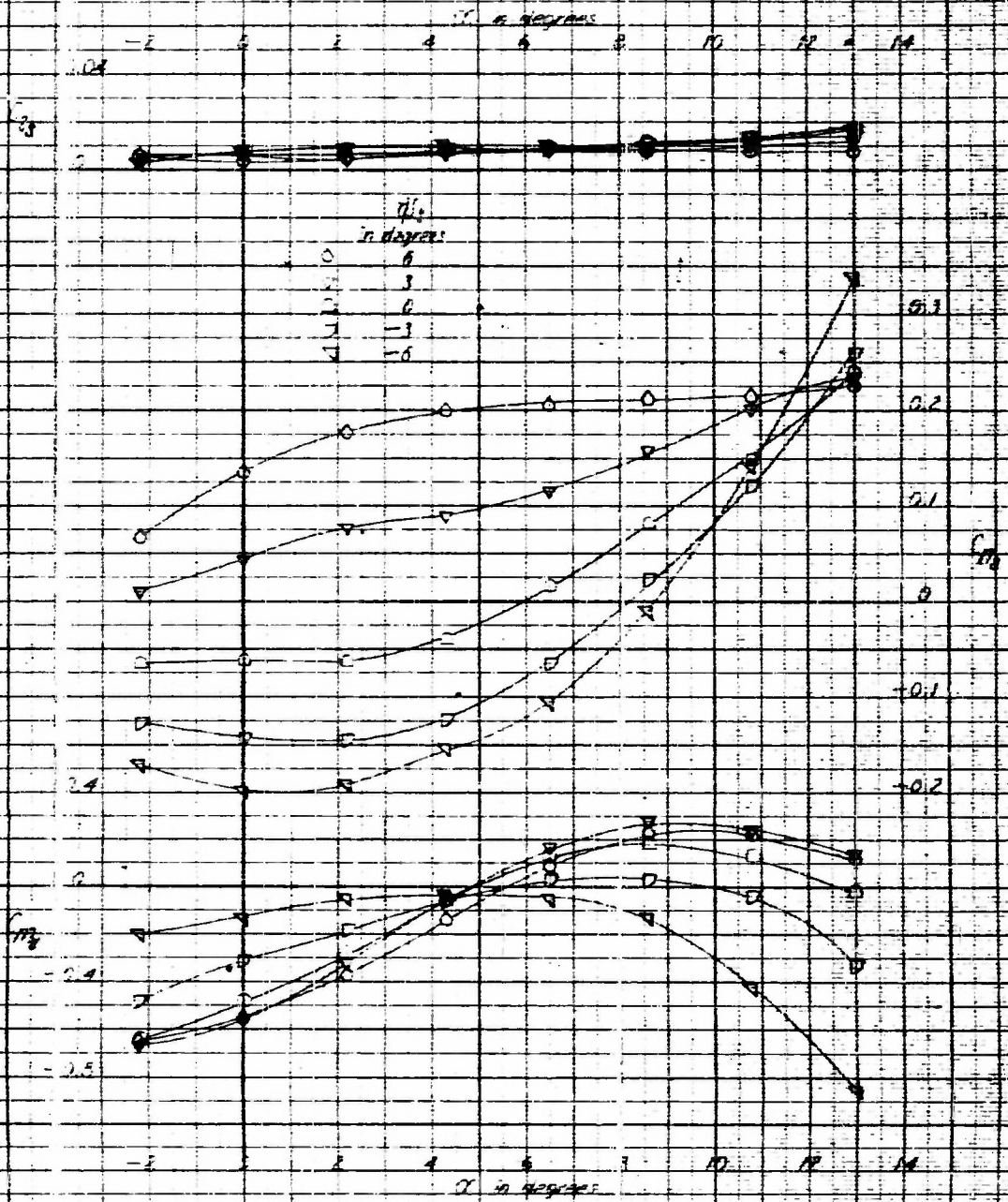
$W/Z = 0.12$ ,  $x = 15$ ,  $Y = 0.05$ ,  $C_0 = 0$ ,  $C_1 = 0$ ,  $C_2 = 0$ ,  $C_3 = 0$

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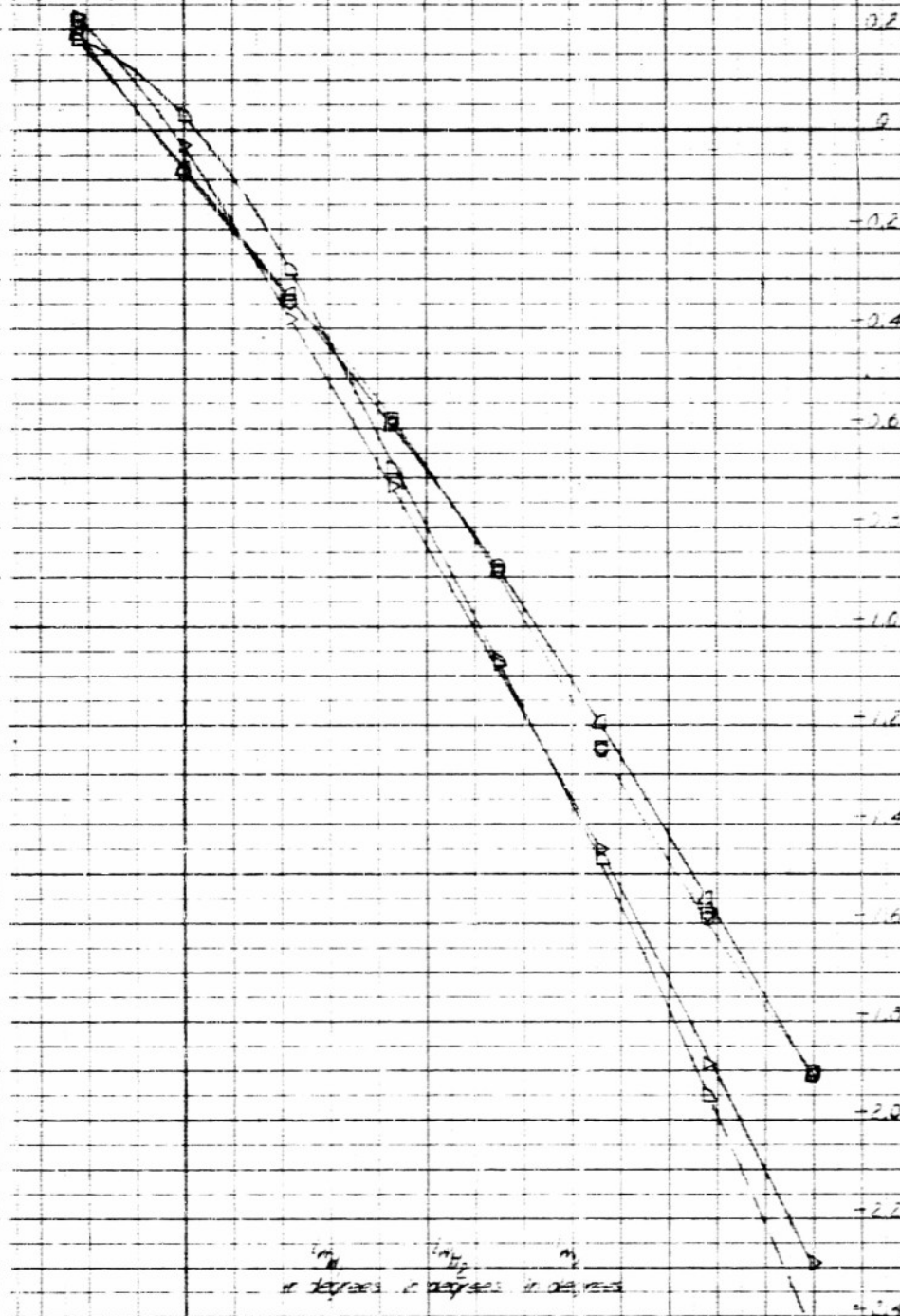
Figure 17 (Continued)  
(d) Continued

FIGURE 17 (Continued)

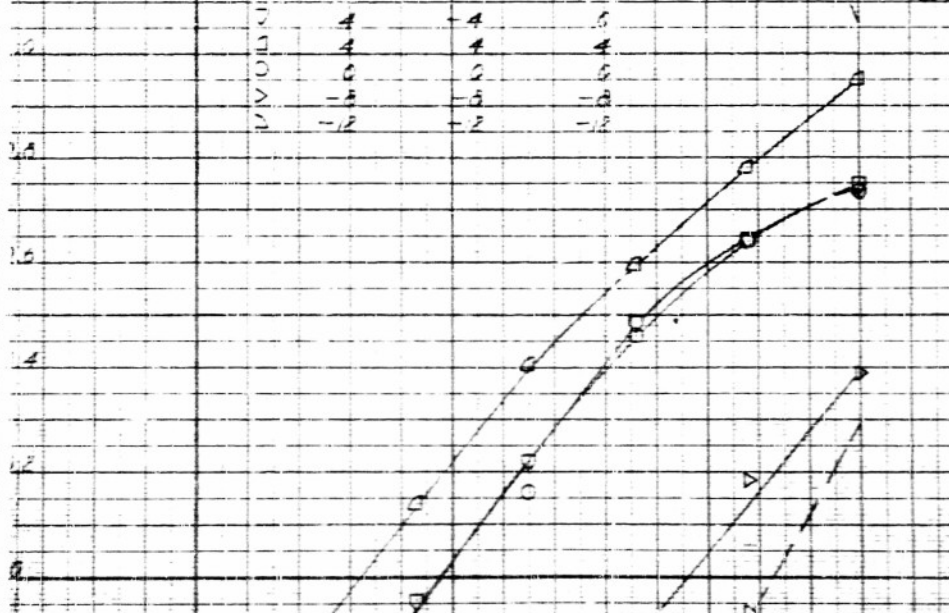
SECRET

SECRET

$\alpha$  in degrees



	$\alpha_1$ in degrees	$\alpha_2$ in degrees	$\alpha_3$ in degrees
1	4	-4	0
2	4	4	4
3	0	0	0
4	-4	-4	-4
5	-12	-2	-12



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1



2

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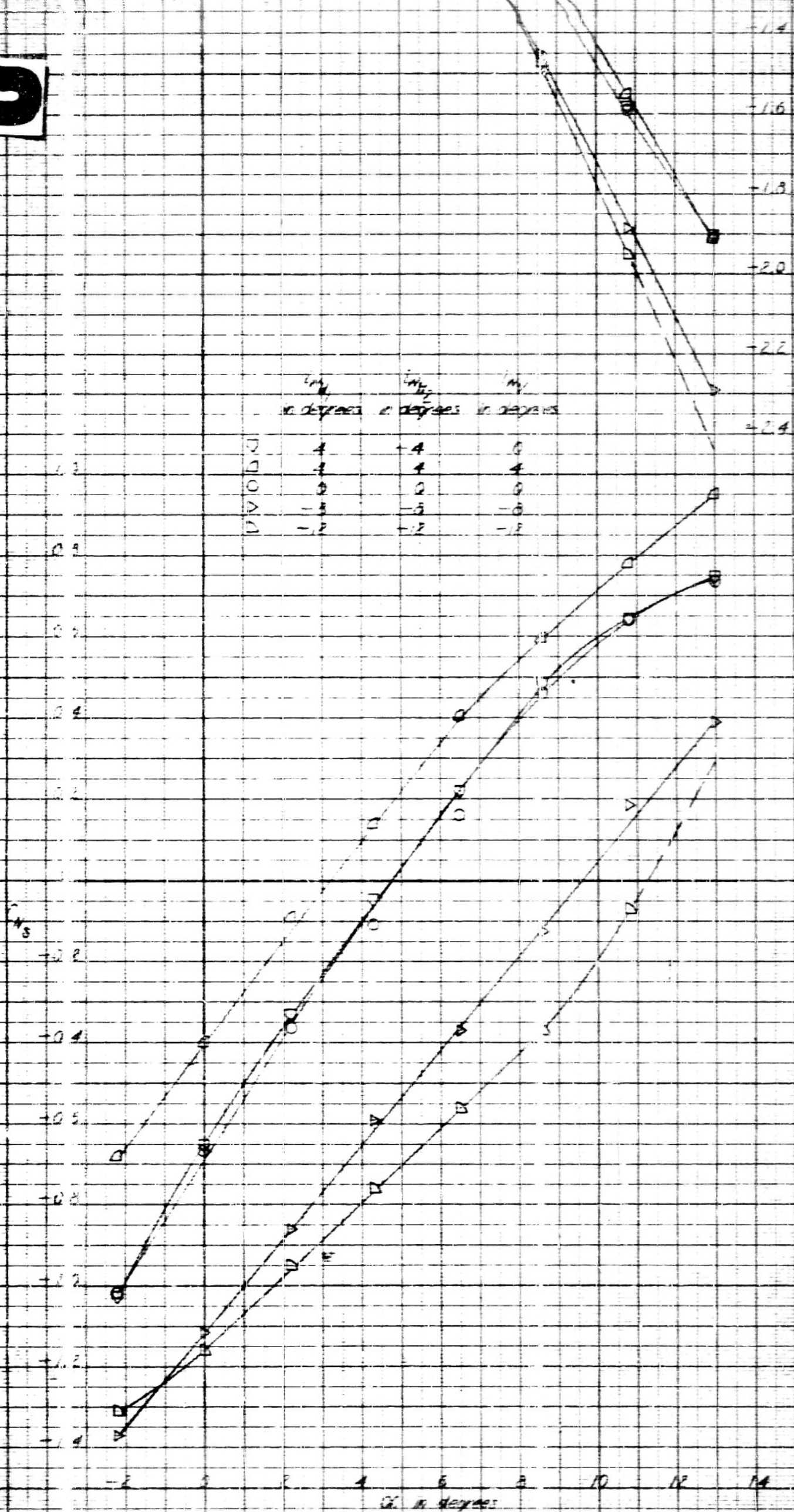


Figure 18 - Aerodynamic Characteristics of a 0.19-Scale Model XAAM-N-4  
Ordnance Missile Due to Missile Wing Incidence in the Proximity of a  
0.19-Scale Model F4D-1 Airplane at 10° Outboard

Continued

(a) Z=0 inch, X=0 inch, theta=0°, phi=0°, psi=0°, Pylon On

FIGURE 18

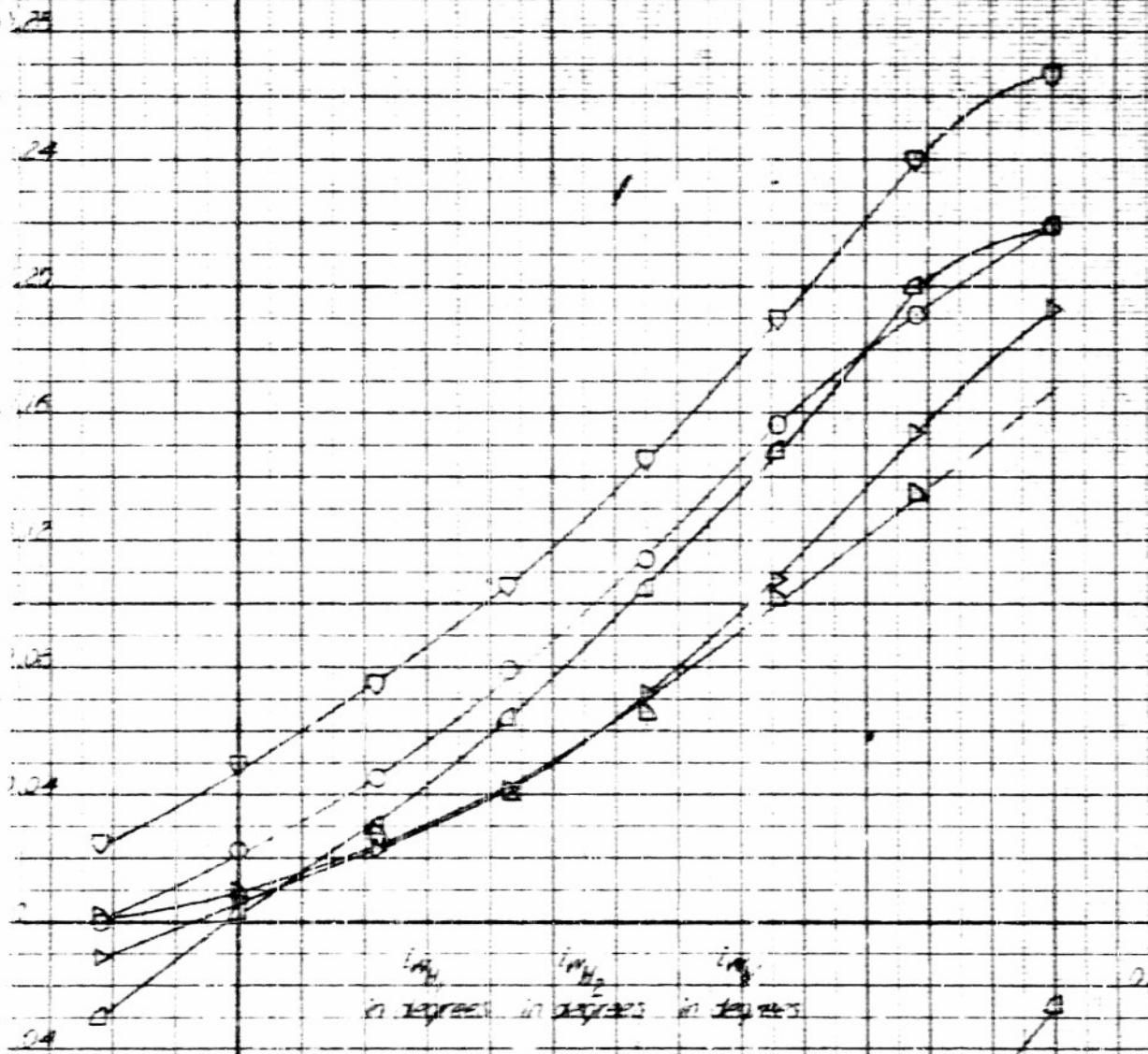
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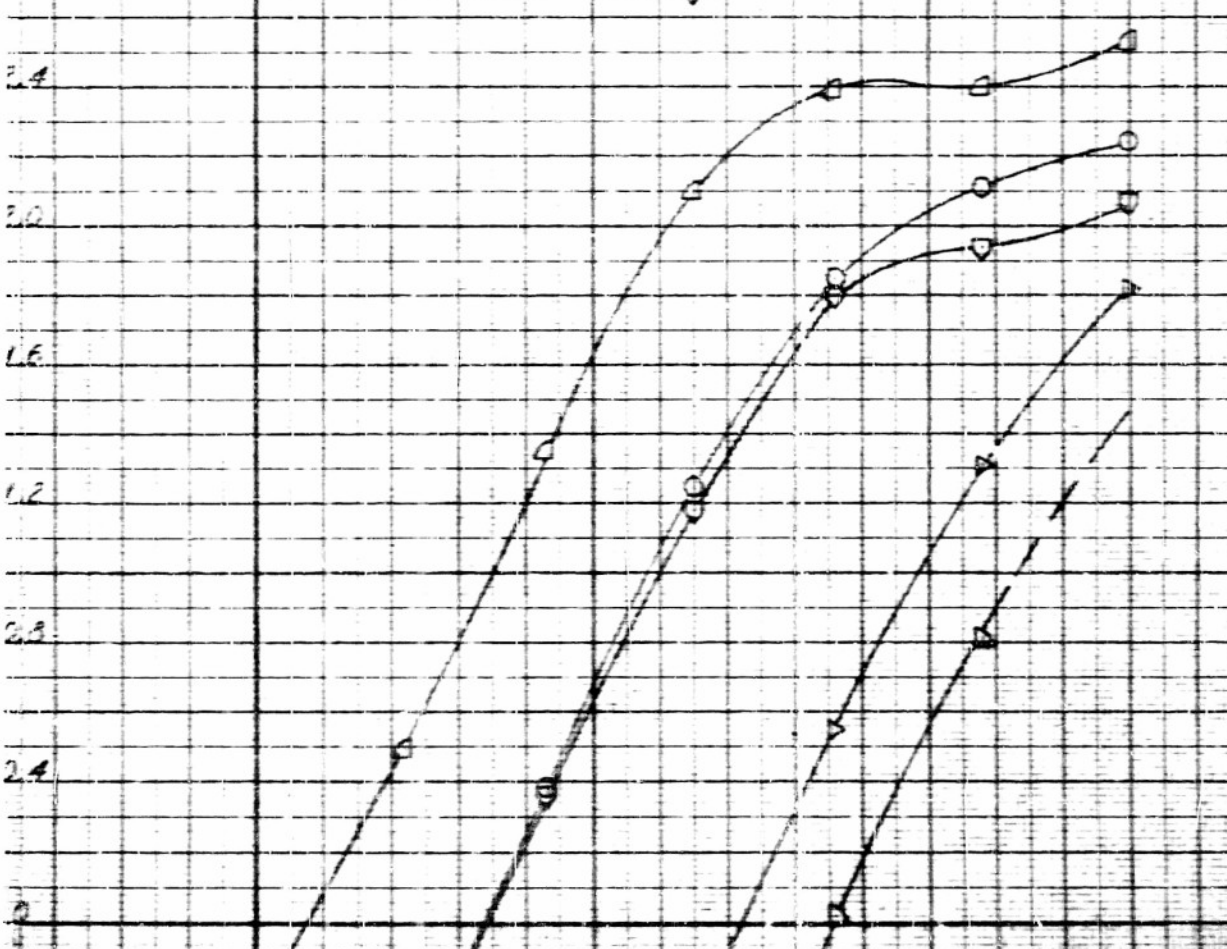
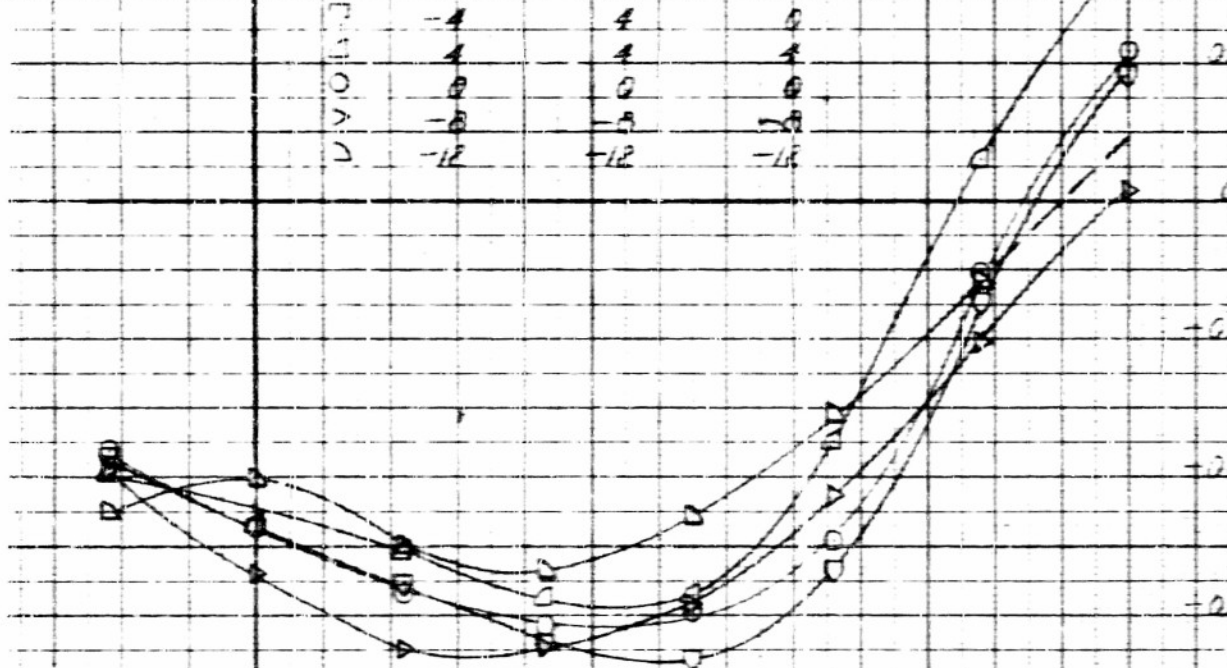
1000000

1000000

$\alpha$  in degrees



	$C_{D1}$	$C_{D2}$	$C_{D3}$
	in degrees	in degrees	in degrees
0.2	-4	4	0
0.1	4	4	4
0	0	0	0
-0.1	-8	-8	-8
-0.2	-12	-12	-12



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2

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FIGURE 18 (Continued)

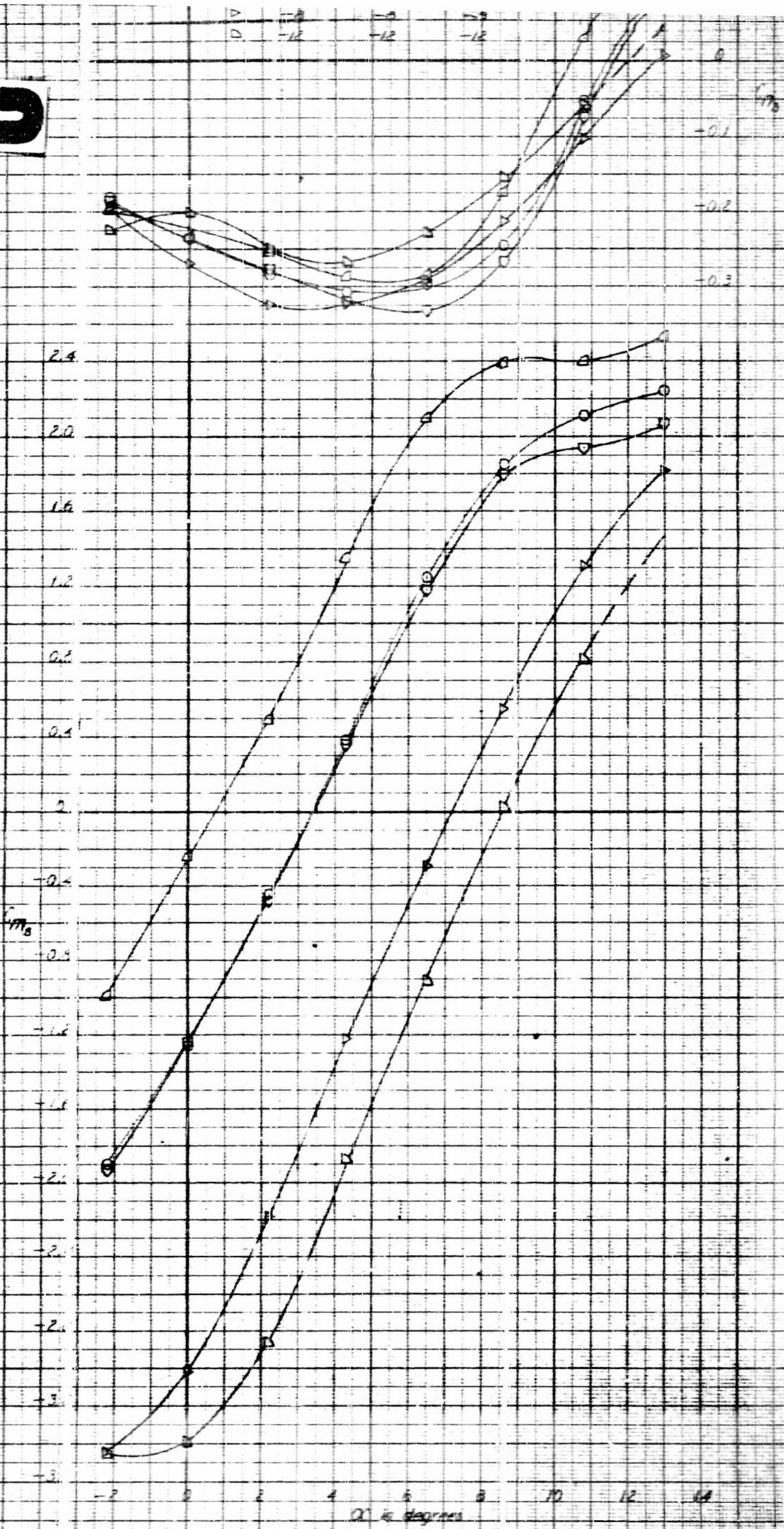


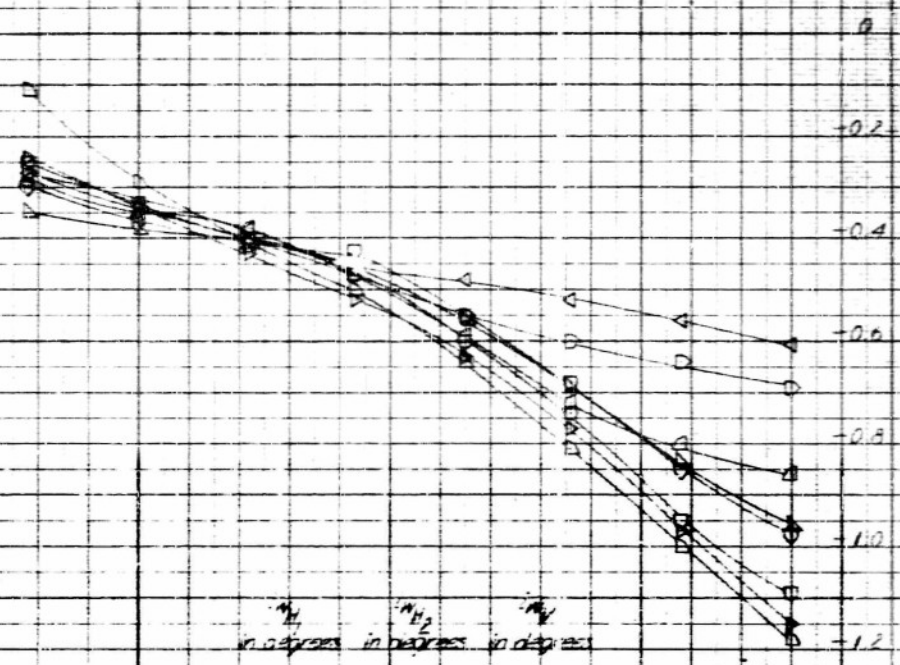
Figure 18 (Continued)  
(a) Continued

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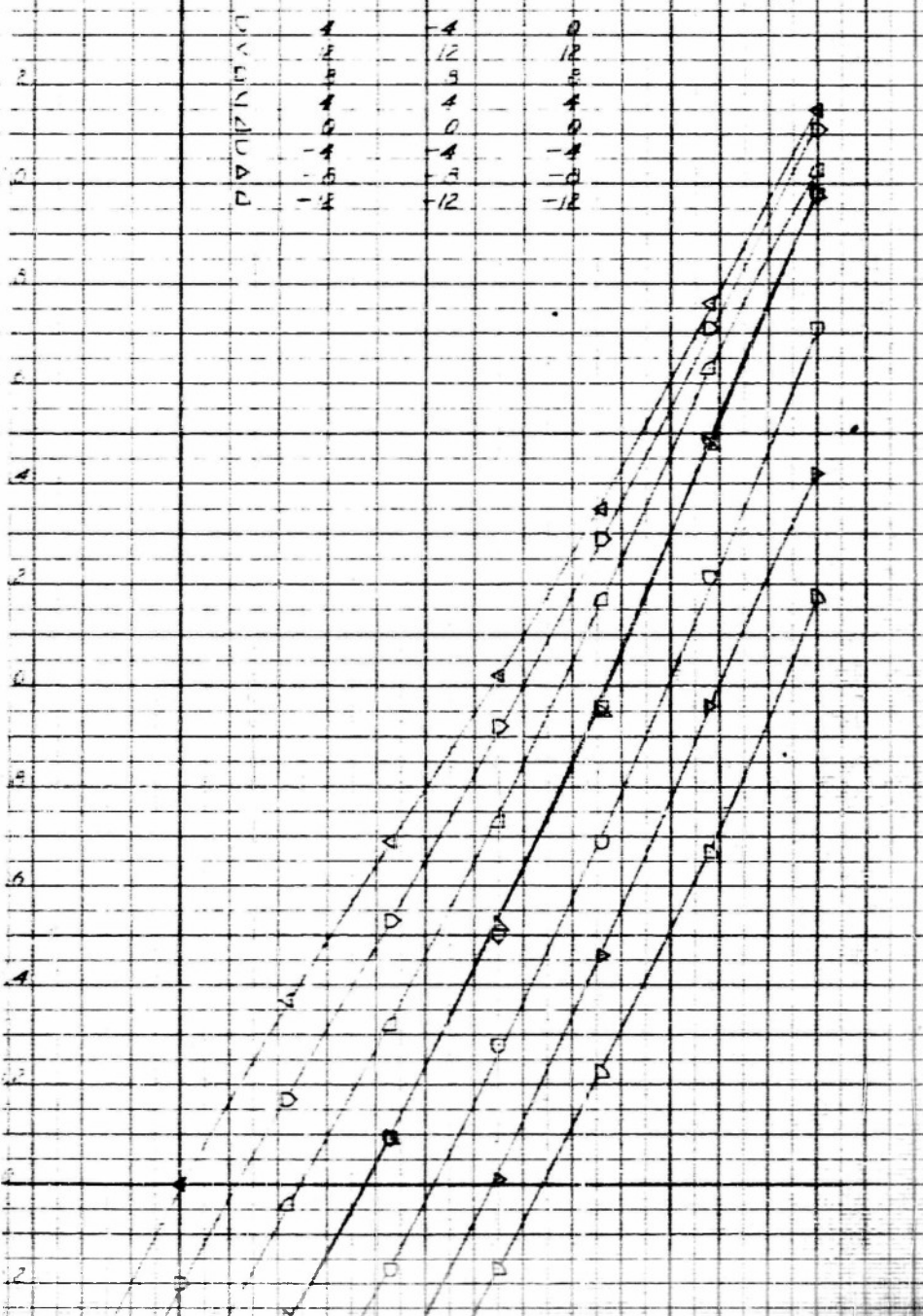


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$\alpha$  in degrees



$M_1$ in degrees	$M_2$ in degrees	$M_3$ in degrees
4	-4	0
2	12	12
5	5	5
4	4	4
0	0	0
-4	-4	-4
-5	-5	-5
-4	-12	-12



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$C_{N_2}$



2

12	12	12
9	9	9
6	6	6
3	3	3
0	0	0
-3	-3	-3
-6	-6	-6
-9	-9	-9
-12	-12	-12

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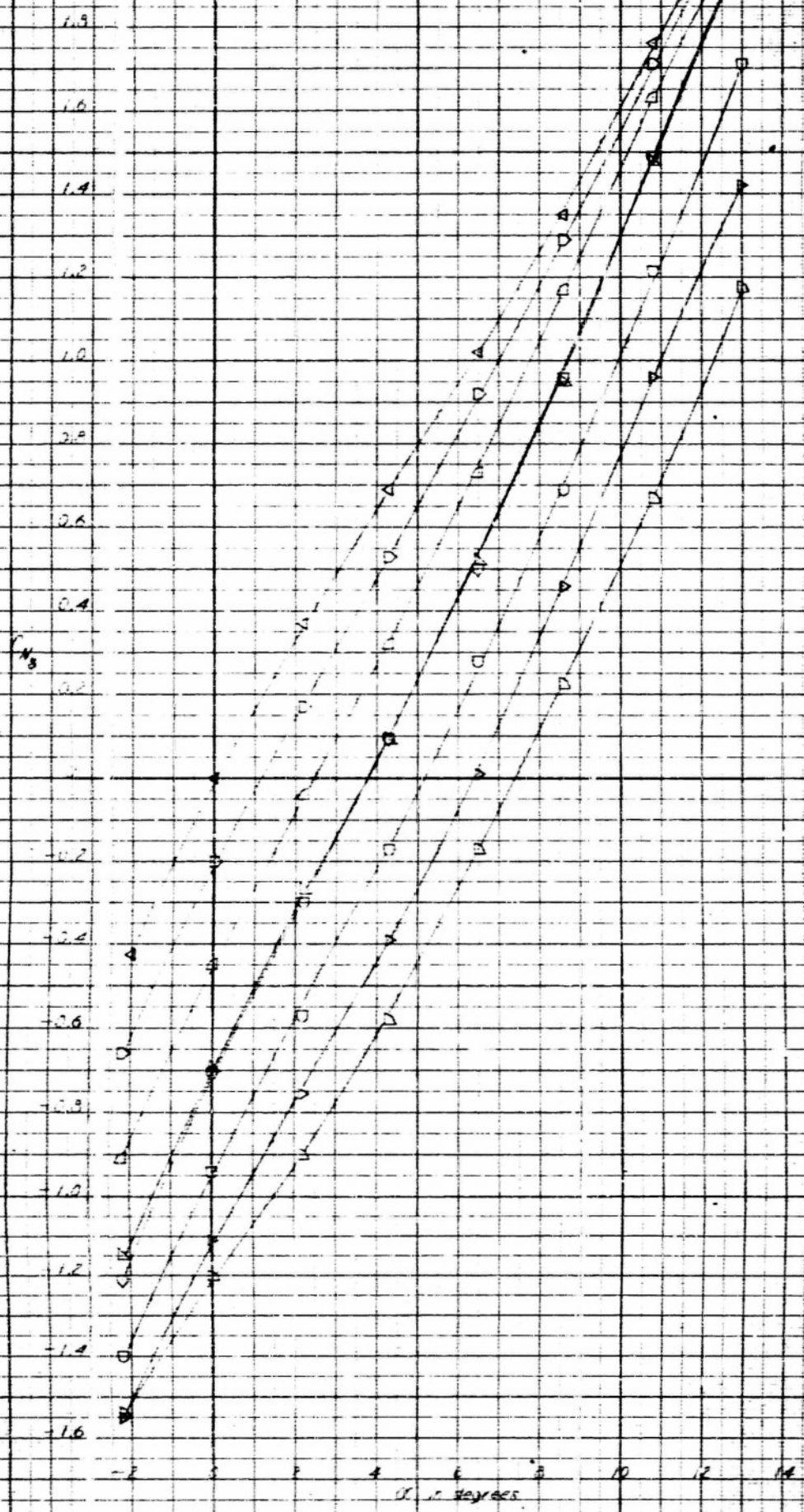


Figure 18B Continued

(a)  $L = 2$  inch,  $A = 13.26$  inches,  $\theta_0 = 0^\circ$ ,  $\theta_1 = 0^\circ$ ,  $\theta_2 = 0^\circ$ , Nylon 66

FIGURE 18B

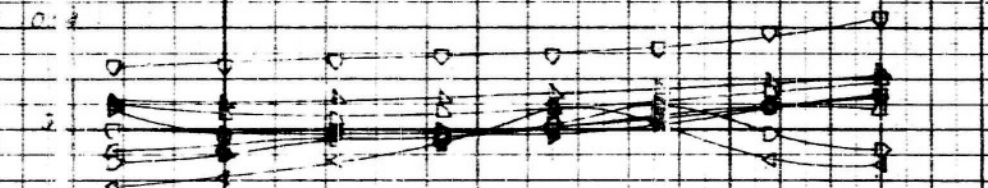
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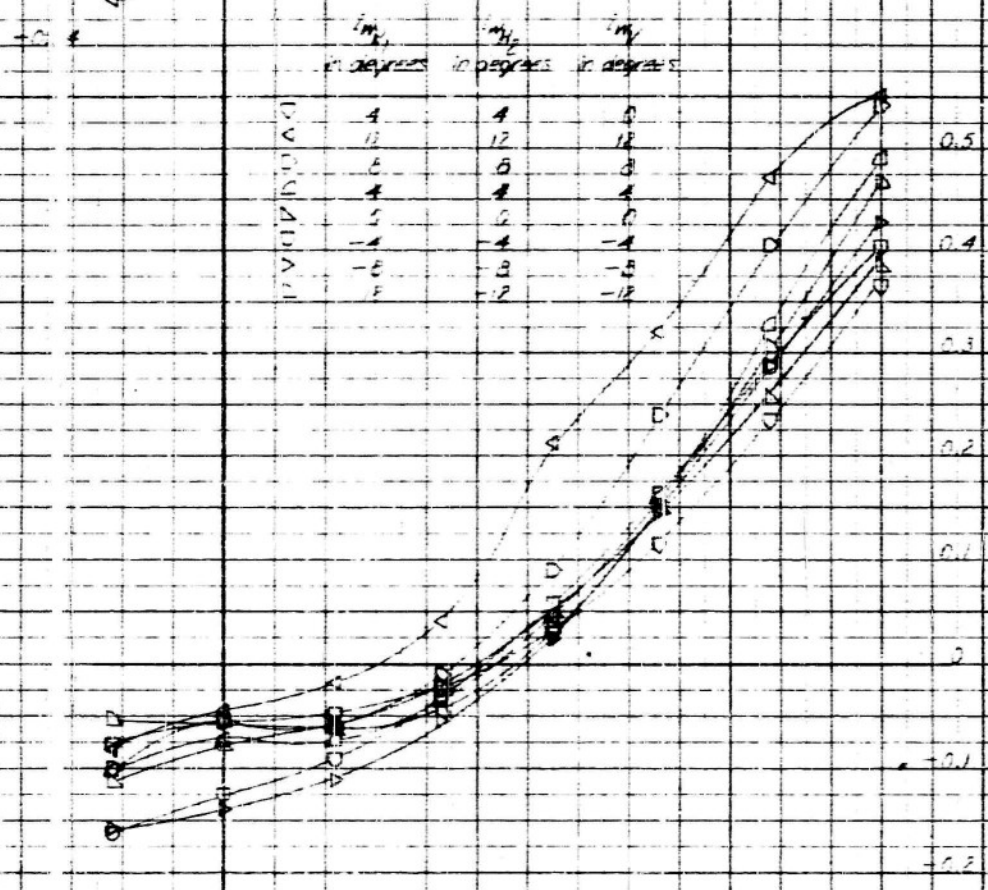
ARJ 764

$\alpha$  in degrees

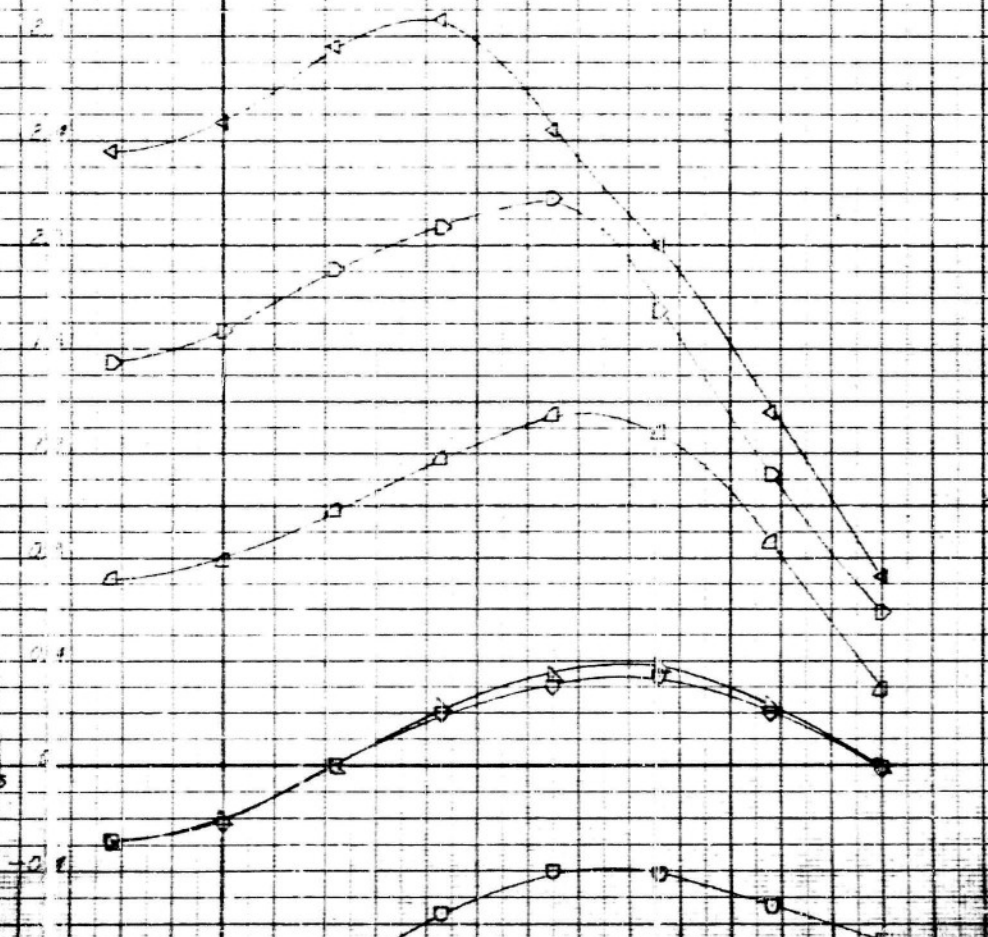
-2 0 2 4 6 8 10 12 14



	$\alpha_1$ in degrees	$\alpha_2$ in degrees	$\alpha_3$ in degrees
1	4	4	0
2	12	12	12
3	6	6	6
4	4	4	4
5	6	6	6
6	-4	-4	-4
7	-6	-6	-6
8	-2	-2	-2



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2

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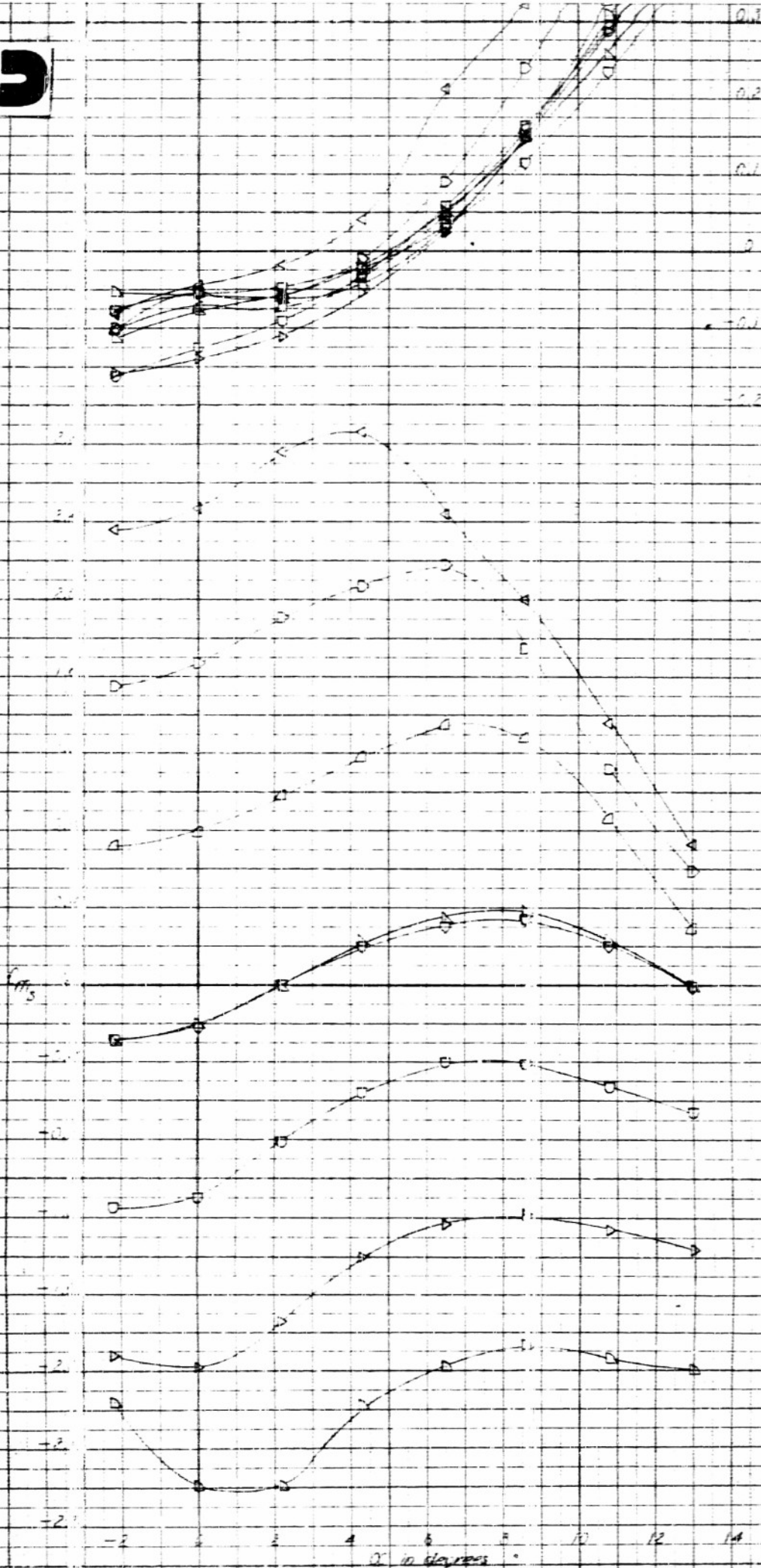


Figure 18 Continued  
(a) Concluded

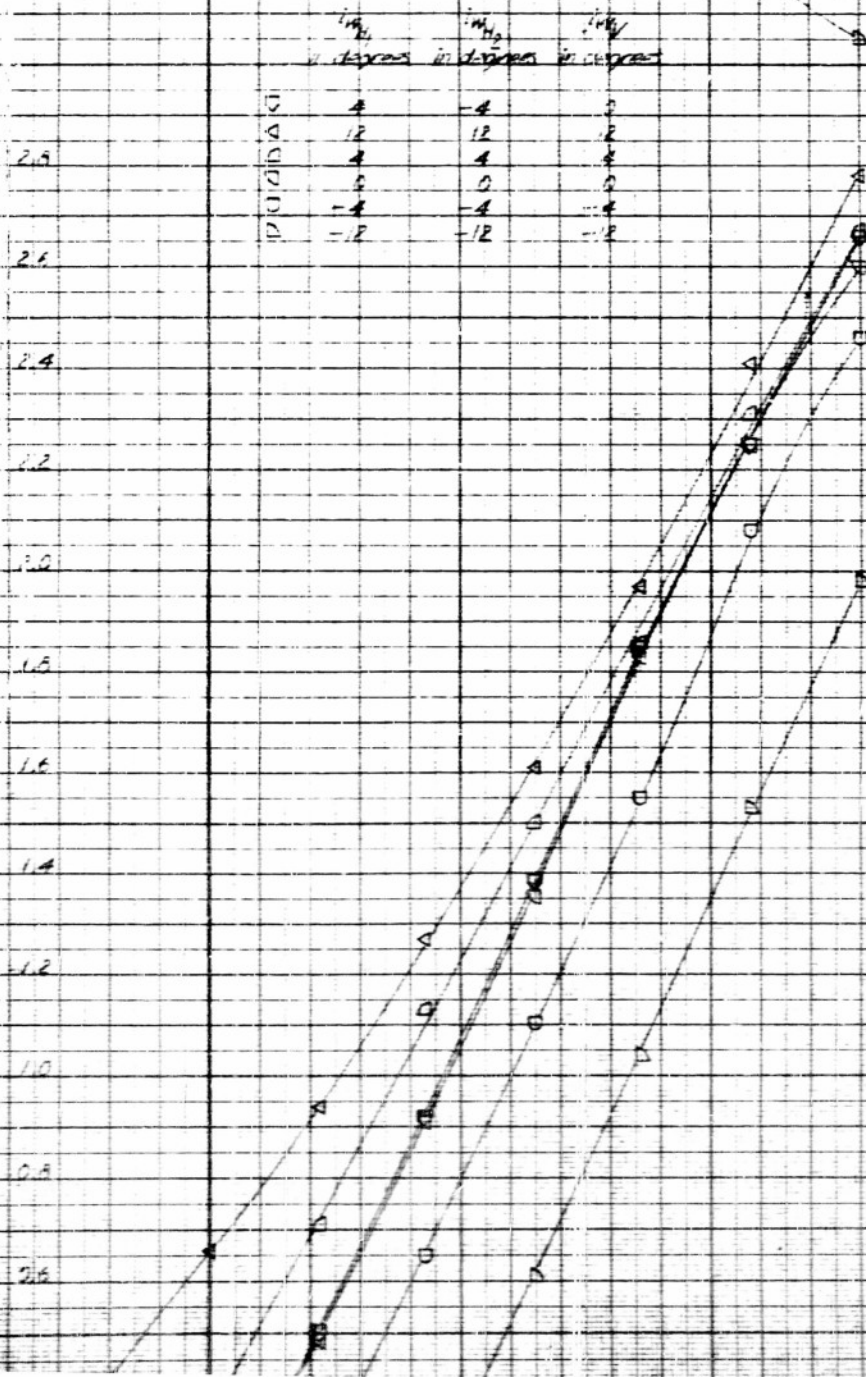
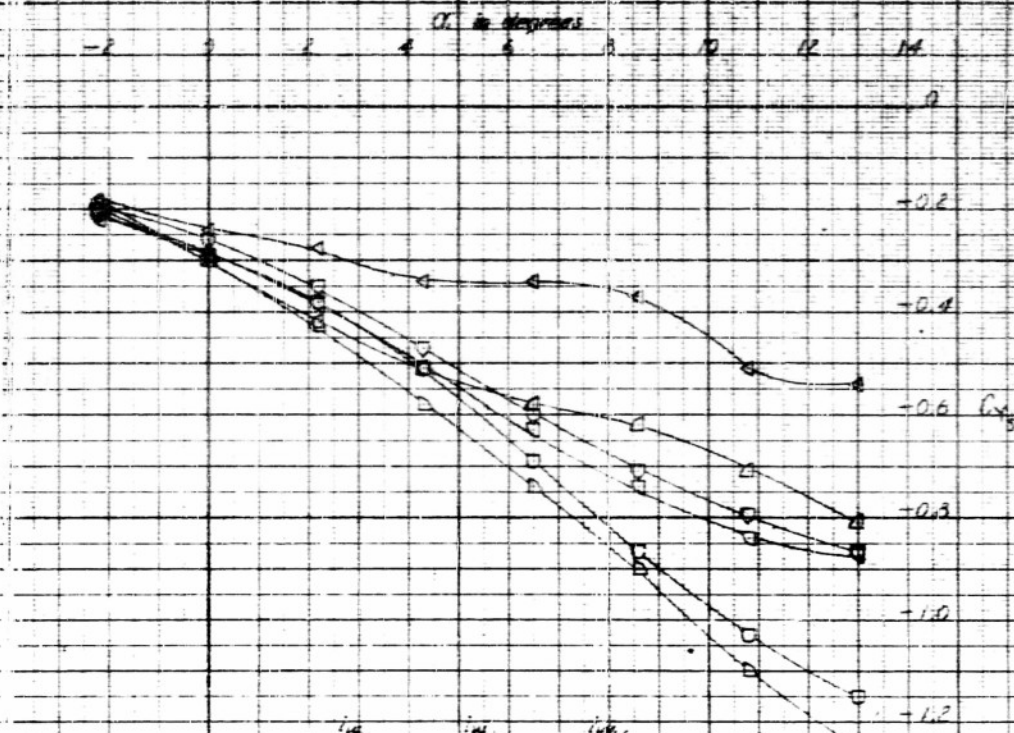
FIGURE 18A (continued)

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14-01000-51



	$\alpha_{H_1}$ in degrees	$\alpha_{H_2}$ in degrees	$\alpha_{H_3}$ in degrees
0.2	4	-4	2
0.4	12	12	2
0.6	4	4	4
0.8	8	0	2
1.0	-4	-4	-4
1.2	-12	-12	-2

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2

0	4	-4	0
0	12	12	12
0	4	4	4
0	0	0	0
0	-4	-4	-4
0	-12	-12	-12

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$\sigma_{N_5}$

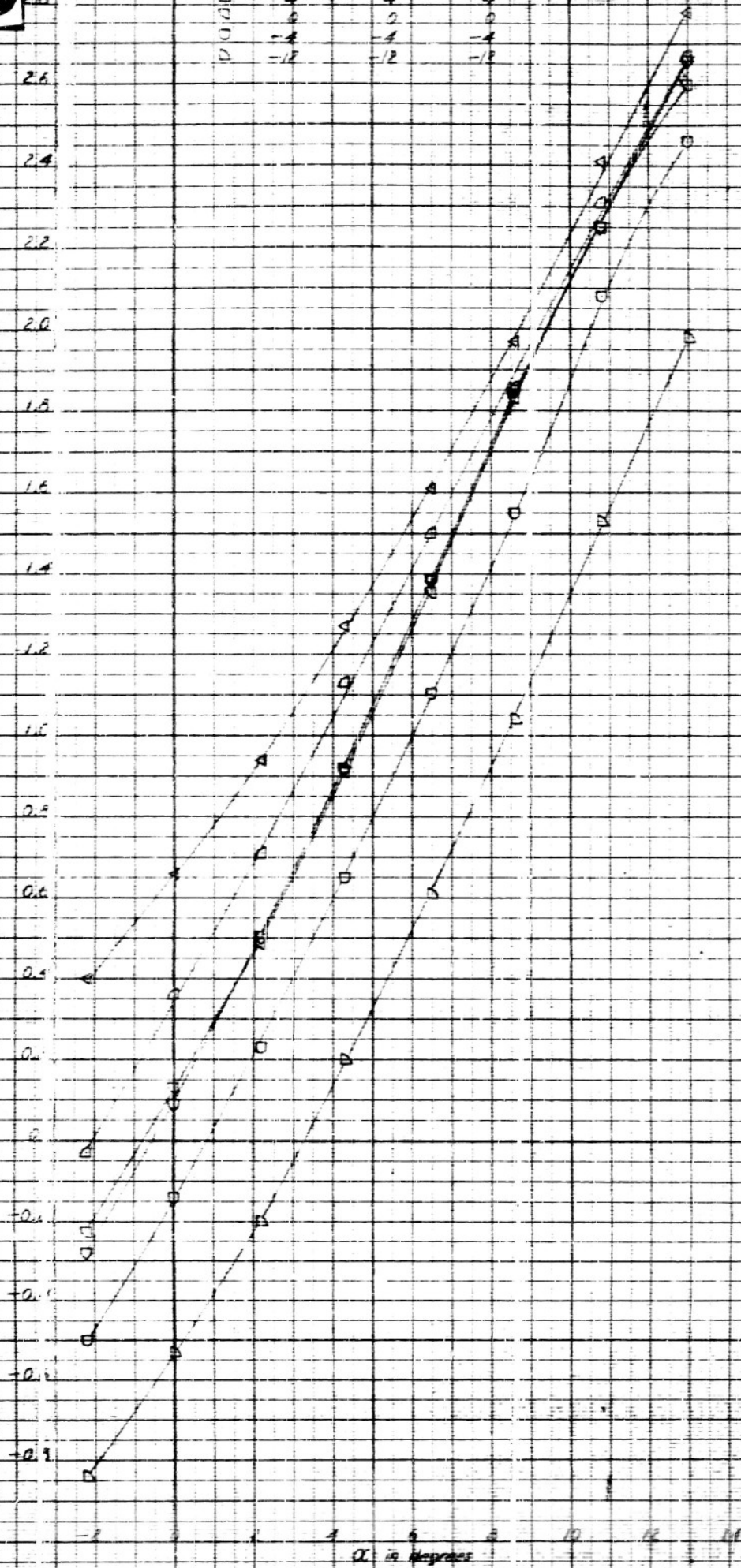


Figure 13 (Continued)

(c)  $Z = 0$  inch,  $X = 13.26$  inches,  $\theta_1 = 6^\circ$ ,  $\theta_2 = 0^\circ$ ,  $\theta_3 = 0^\circ$ ,  $E$  from On

FIGURE 13

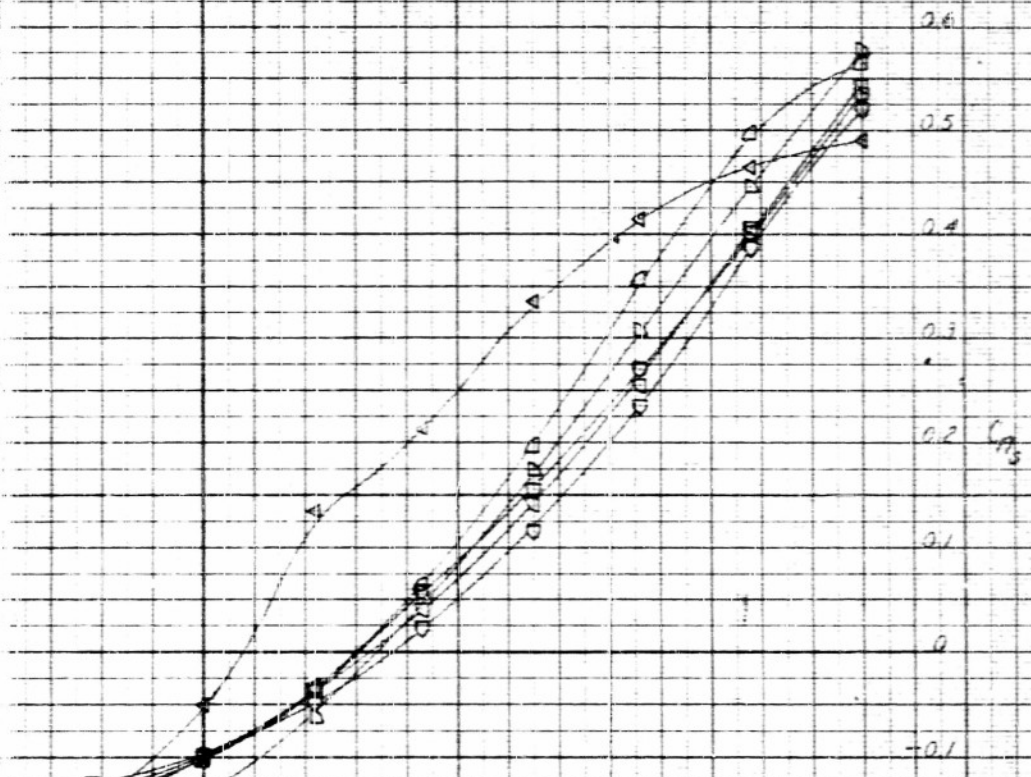
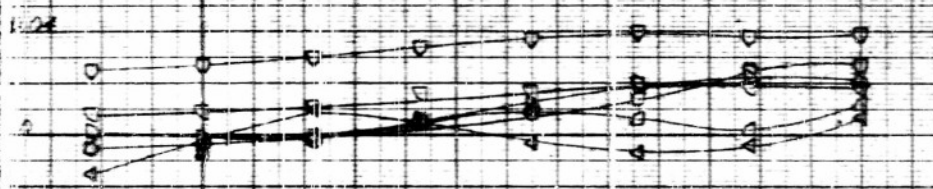
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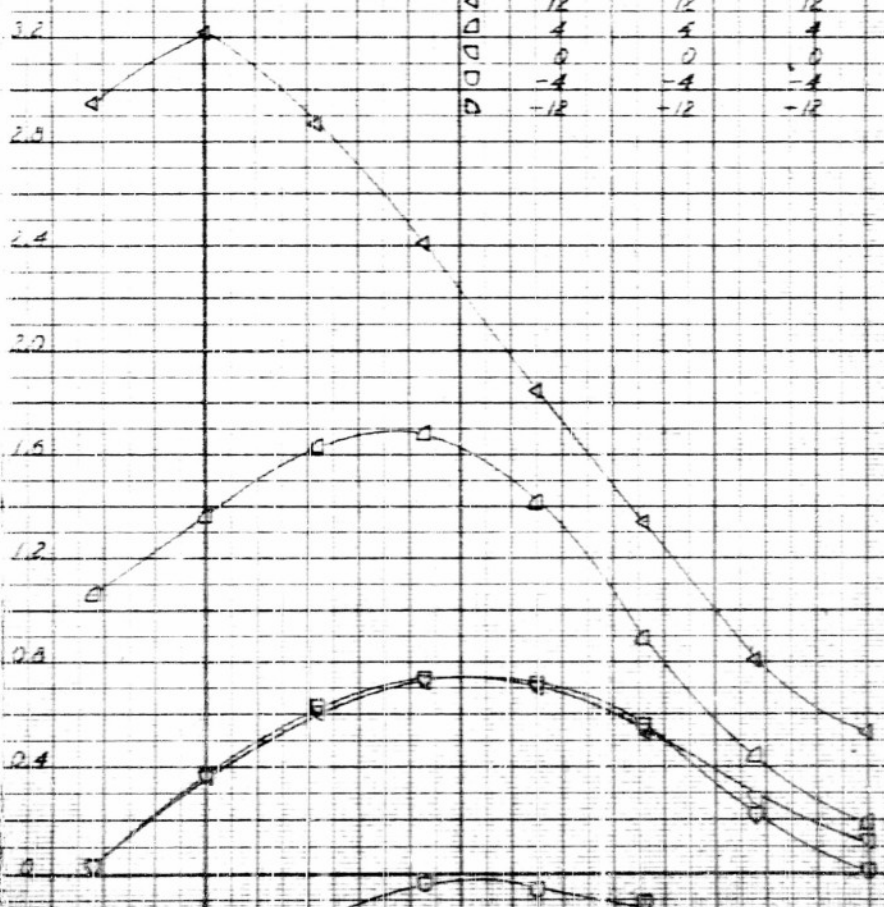
PT 450154

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$\alpha$  in degrees



	$\alpha_{H_1}$ in degrees	$\alpha_{H_2}$ in degrees	$\alpha_{H_3}$ in degrees
D	4	-4	0
D	12	12	12
D	4	4	4
D	0	0	0
D	-4	-4	-4
D	-12	-12	-12



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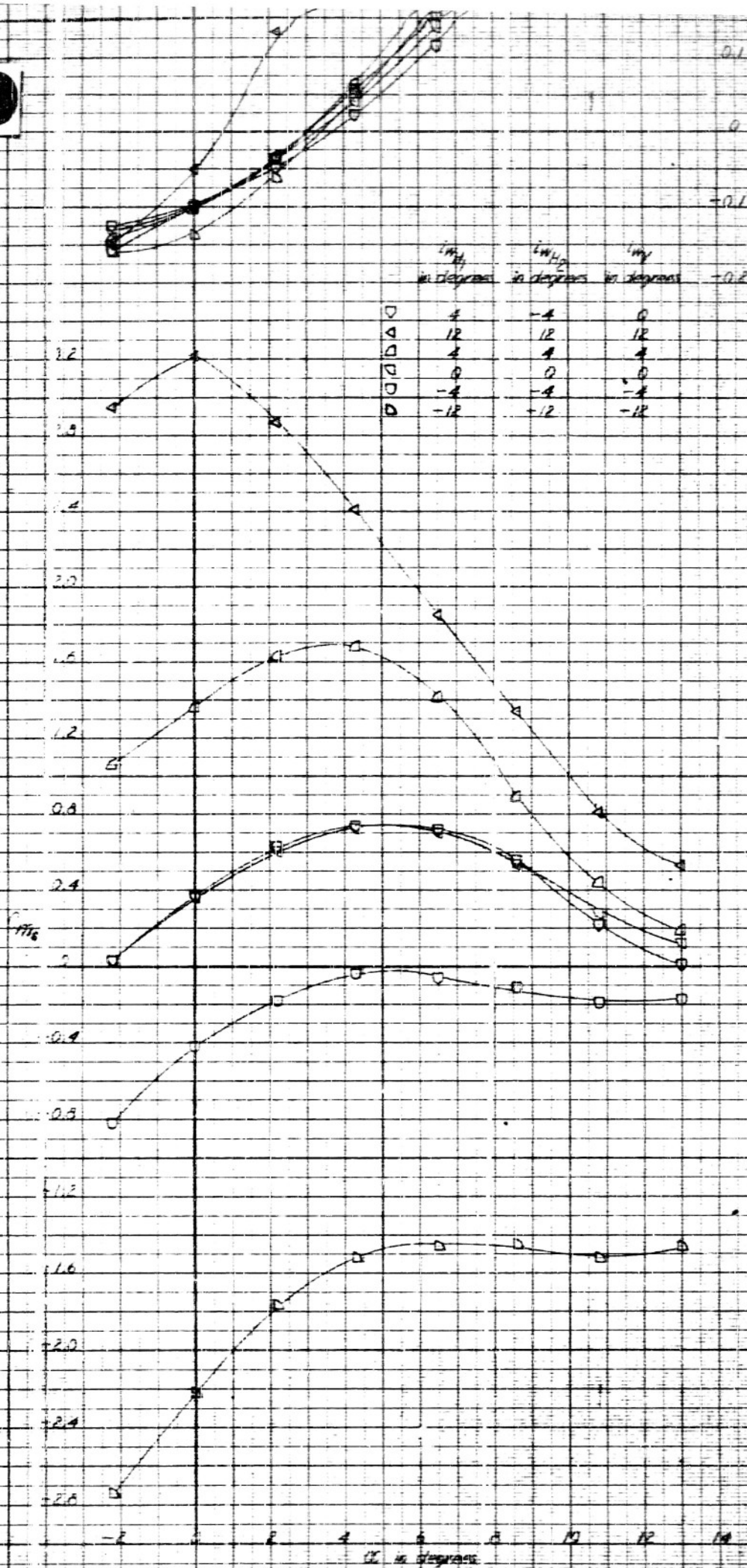


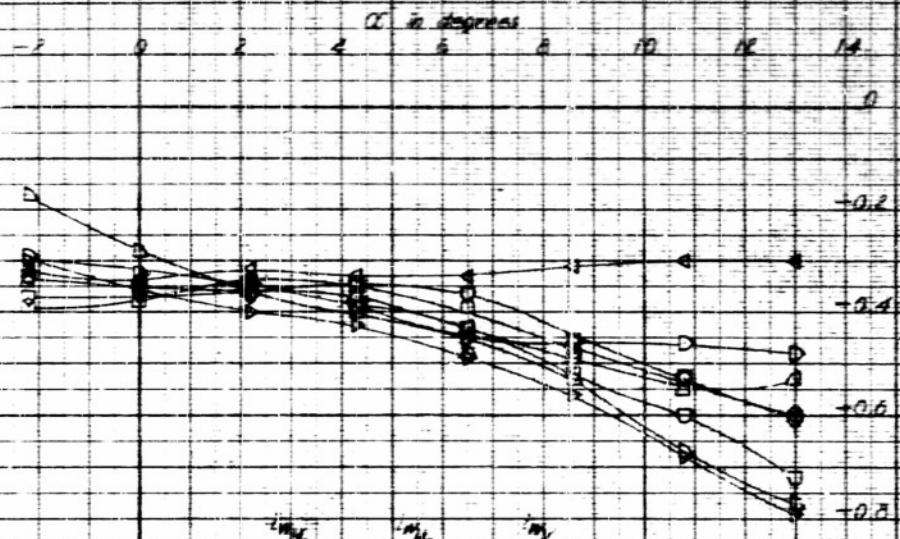
FIGURE 10 (Continued)

Figure 10 (Continued)  
(a) Concluded

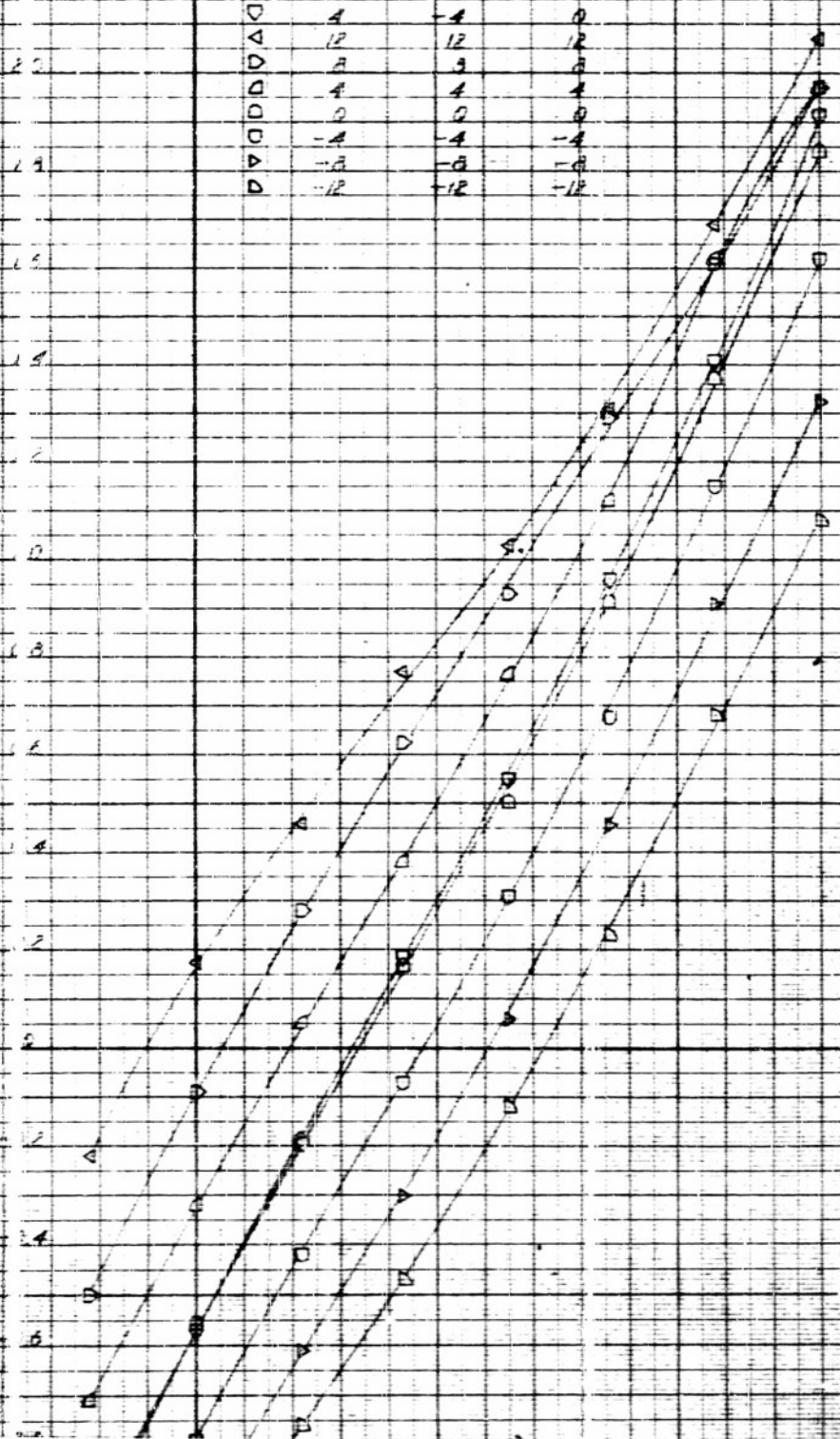
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REF 064



	$\alpha_1$ in degrees	$\alpha_2$ in degrees	$\alpha_3$ in degrees
▽	4	-4	0
△	12	12	12
▽	8	8	8
△	4	4	4
▽	0	0	0
△	-4	-4	-4
▽	-8	-8	-8
△	-12	-12	-12



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2

	$\alpha_{10}$ in degrees	$\alpha_{10/2}$ in degrees	$\alpha_{10}$ in degrees
0	4	-4	0
1	12	12	12
2	4	3	3
3	4	4	4
4	0	0	0
5	-4	-4	-4
6	-8	-8	-8
7	-12	-12	-12

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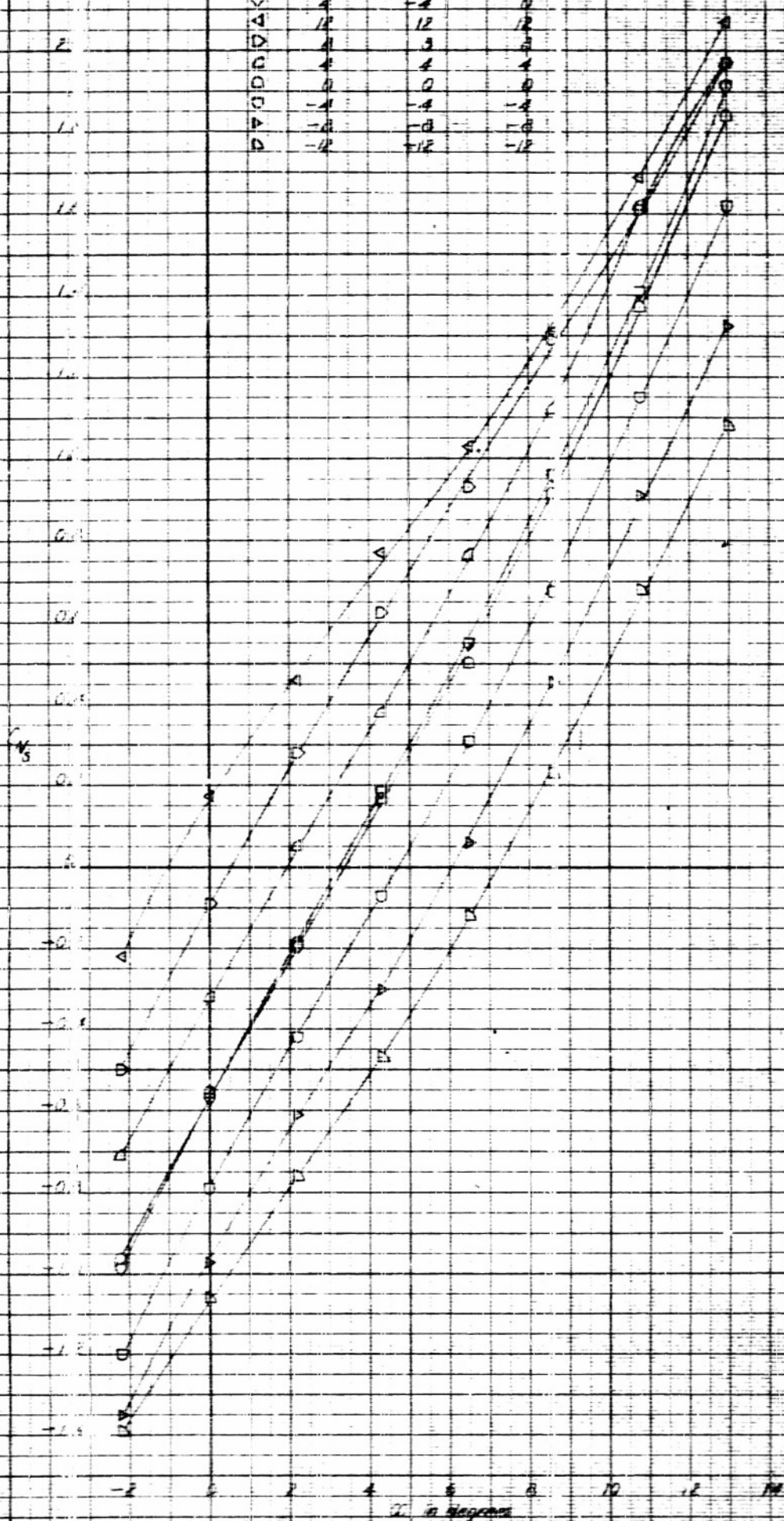


Figure 18 (Continued)

(1)  $P = 5$  inch,  $X = 13.36$  inches,  $\theta_0 = 0^\circ$ ,  $\theta_1 = 0^\circ$ ,  $\theta_2 = 0^\circ$ ,  $P_{10} = 0$

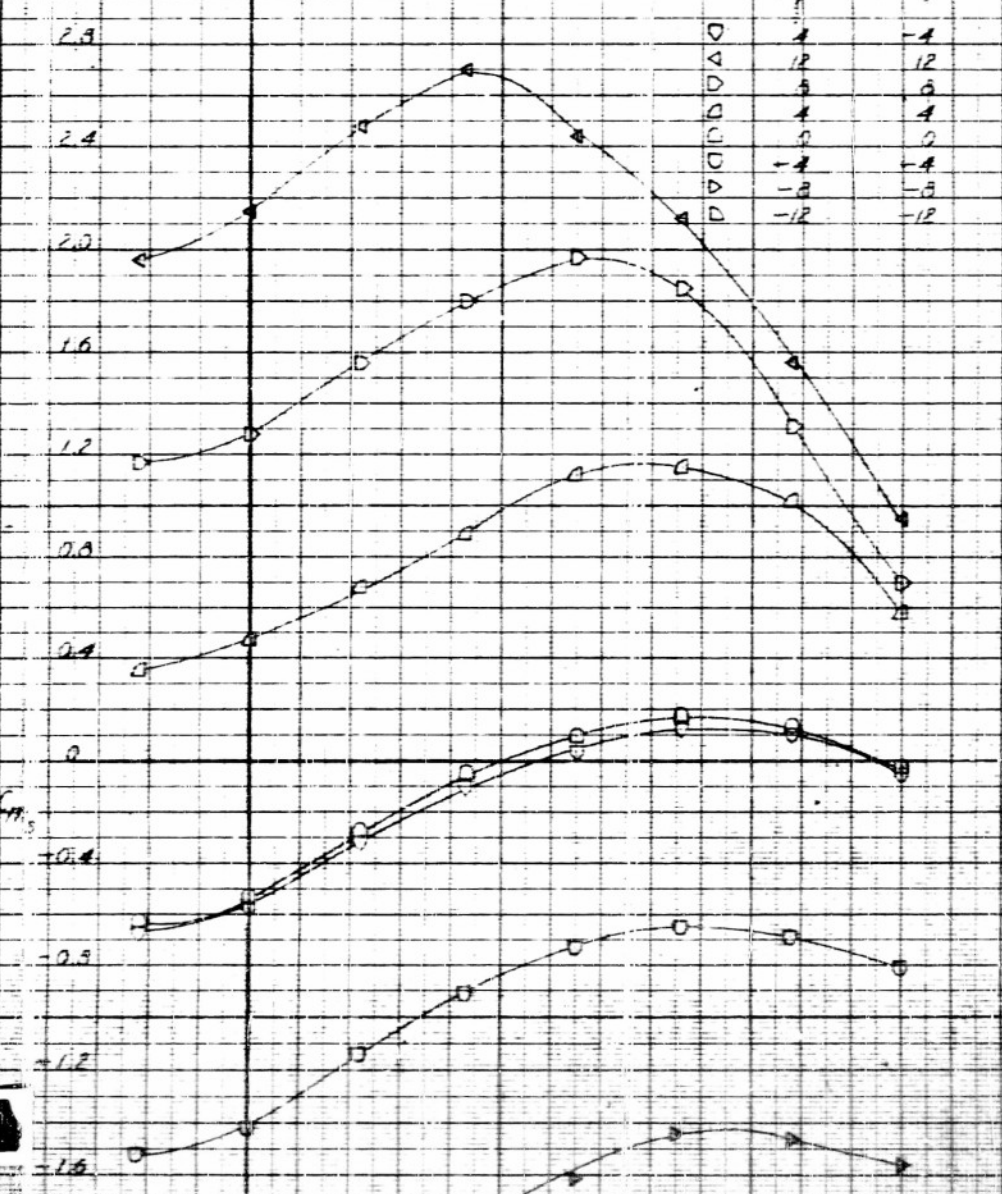
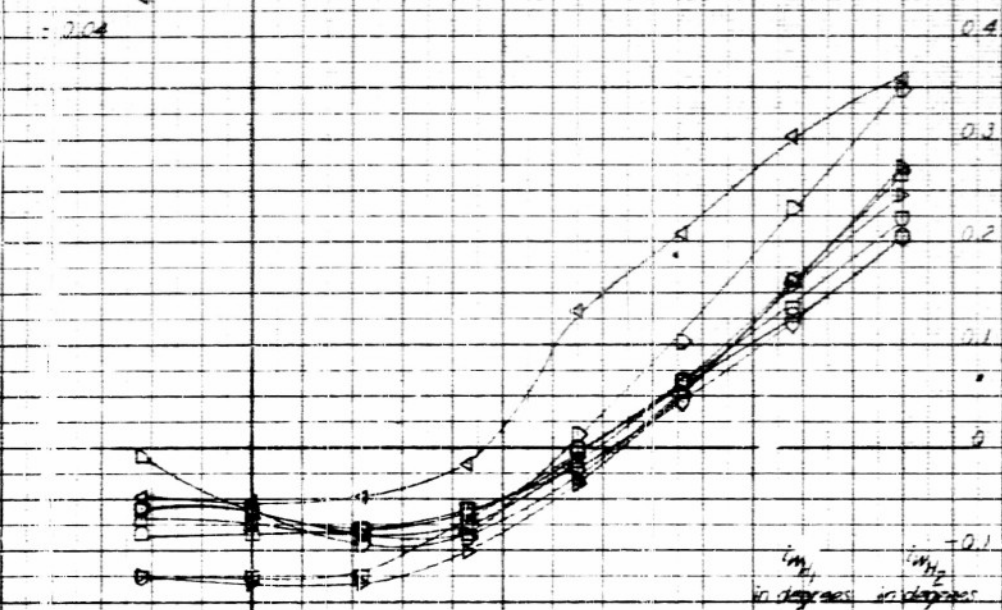
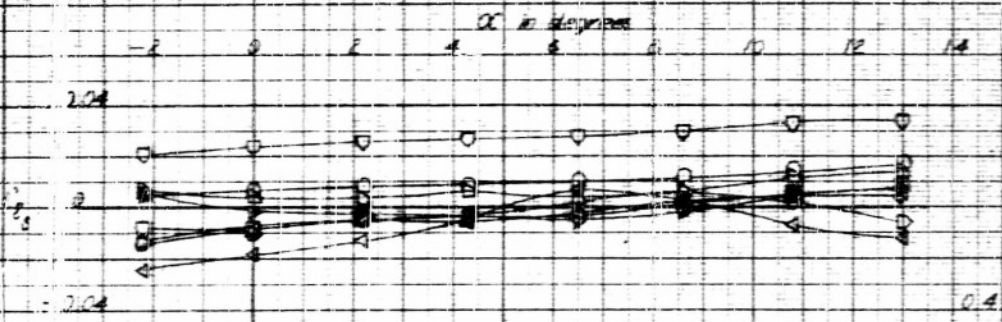
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FIGURE 18-1



0.45/0.54

0.45/0.54



	$\alpha_{M_1}$ in degrees	$\alpha_{M_2}$ in degrees	$\alpha_{M_3}$ in degrees
▽	4	-4	9
△	12	12	12
▽	9	9	9
△	4	4	4
▽	9	9	9
△	-4	-4	-4
▽	-9	-9	-9
△	-12	-12	-12

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2

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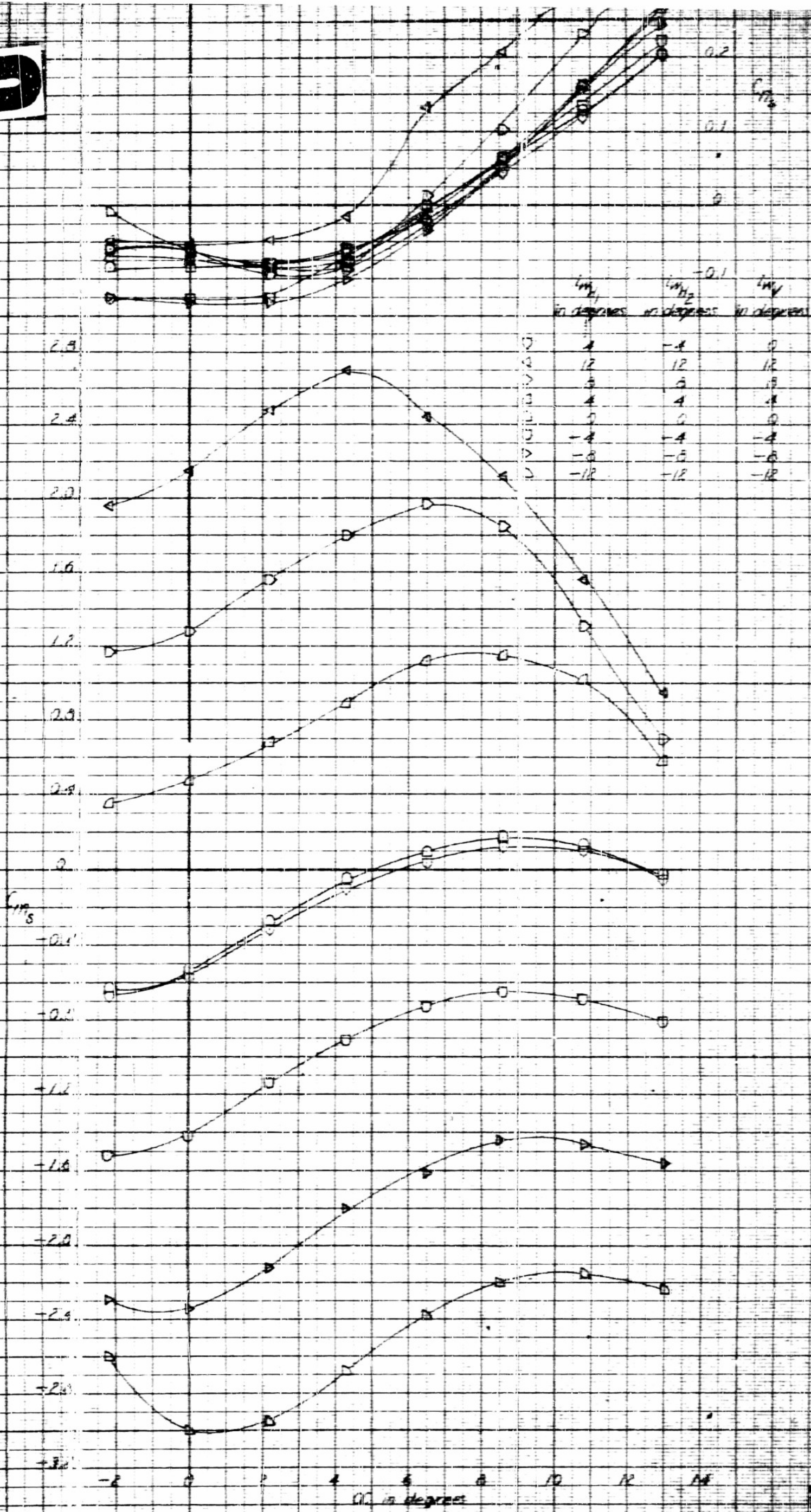


FIGURE 18 (Continued)

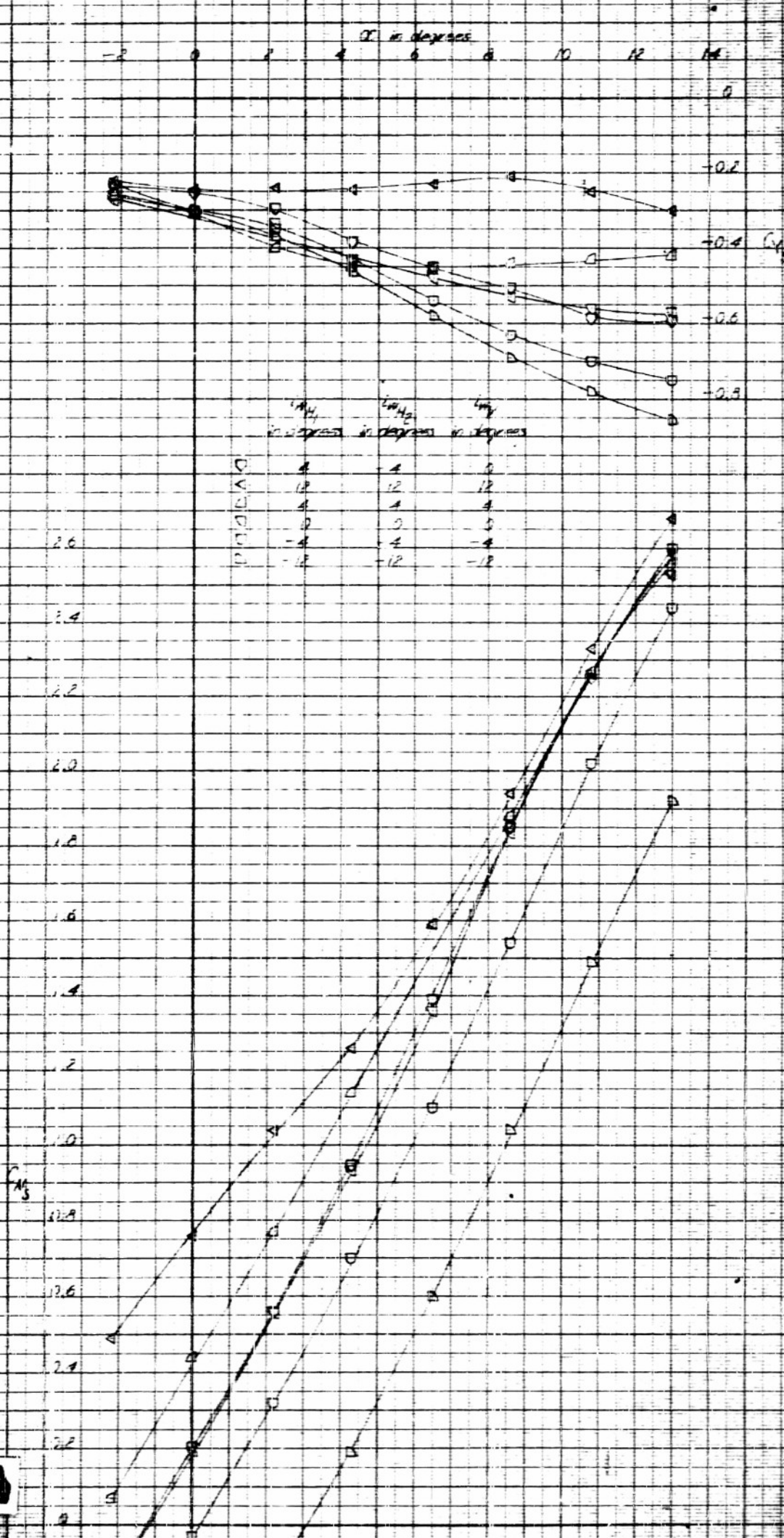
Figure 18 (Continued)  
18 Concluded

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ALCO 254

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2

	$L_{H_1}$ in degrees	$L_{H_2}$ in degrees	$L_{H_3}$ in degrees
D	4	-4	0
V	12	12	12
D	4	4	4
D	0	0	0
D	-4	-4	-4
D	-12	-12	-12

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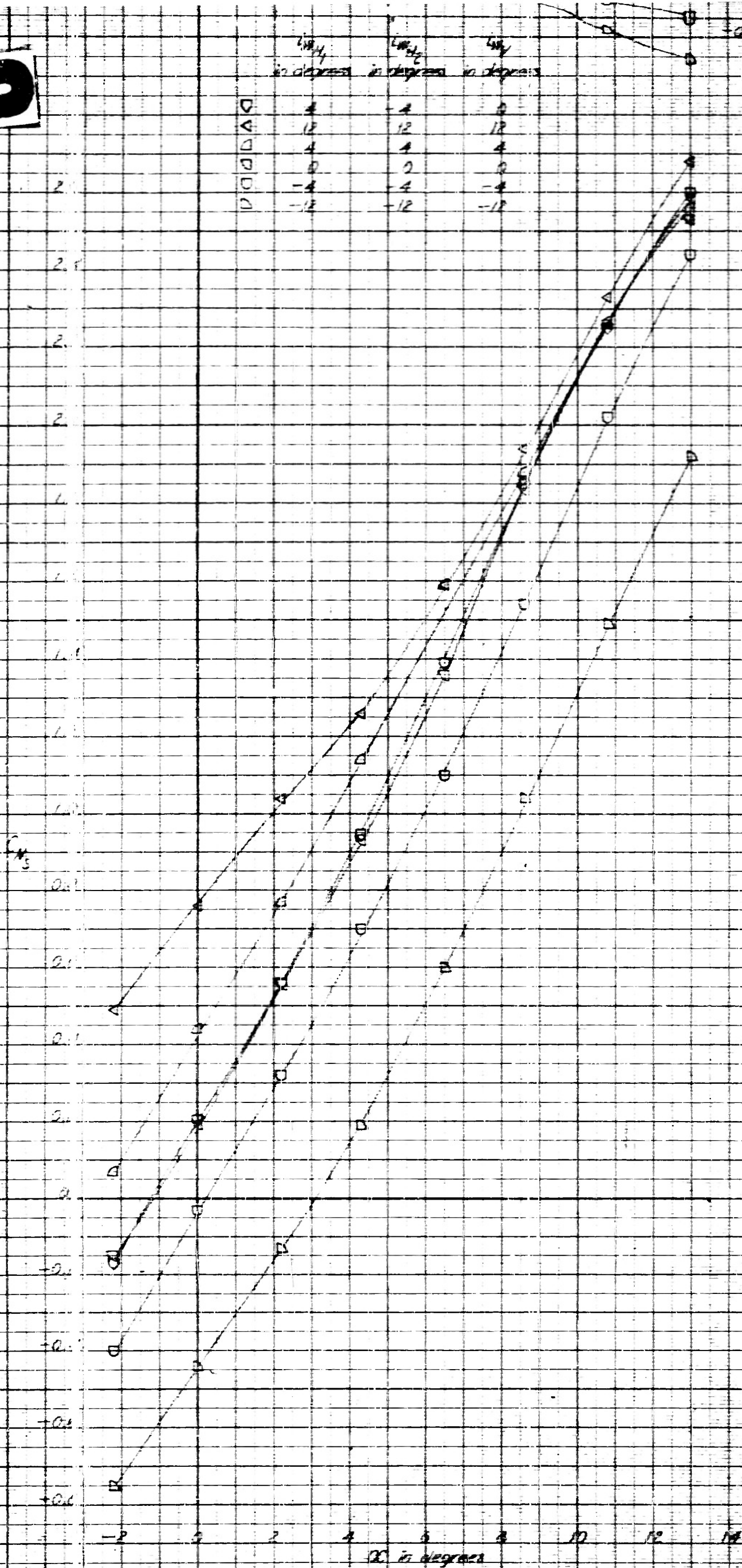


FIGURE 18A

Figure 18 (Continued)

$\phi_1 = 0.12$ ,  $X = 10.36$  inches,  $\theta_3 = 6^\circ$ ,  $\psi_3 = 0^\circ$ ,  $\psi = 0^\circ$ ,  $P_{\text{dyn}} = 0$

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01444154

27 in degrees

AREA 1544

0.04

0

0.4

0.3

0.2

0.1

0

-0.1

$C_{17}$

$\alpha_1$  in degrees     $\alpha_2$  in degrees     $\alpha_3$  in degrees

△	4	-4	0
▽	12	12	12
△	4	4	4
▽	0	0	0
△	-4	-4	-4
▽	-12	-12	-12

3.2

2.8

2.4

2.0

1.6

1.2

0.8

0.4

0

-0.4

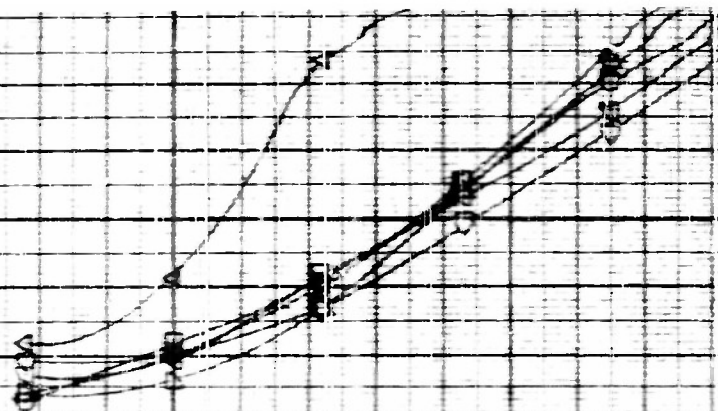
-0.8

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1



2



	$\alpha_1$ in degrees	$\alpha_2$ in degrees	$\alpha_3$ in degrees
D	4	-4	0
\Delta	12	12	12
\nabla	4	4	4
O	0	0	0
\square	-4	-4	-4
\circ	-12	-12	-12

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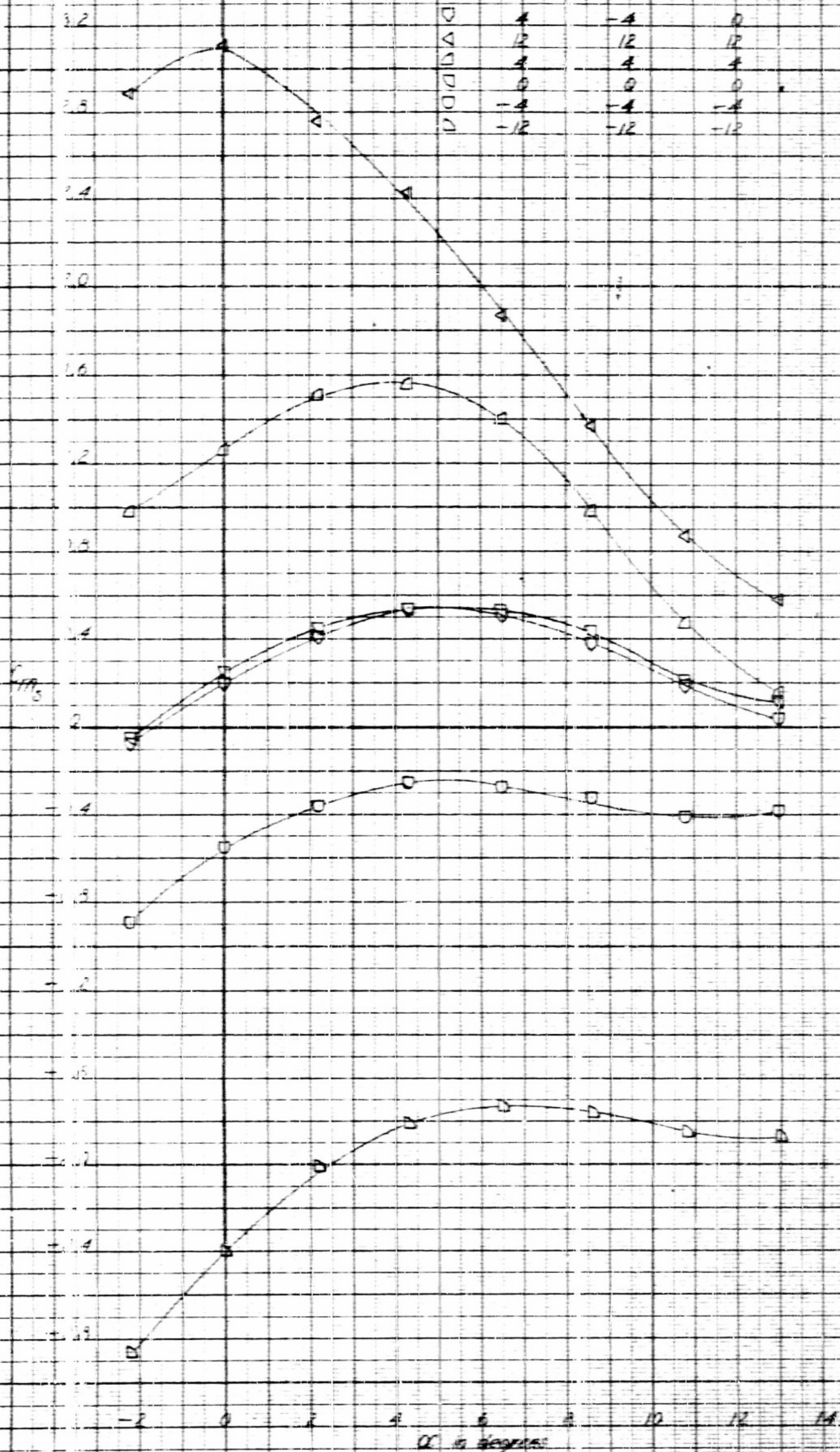


FIGURE 18 (Continued)

Figure 18 (Continued)  
(a) Concluded

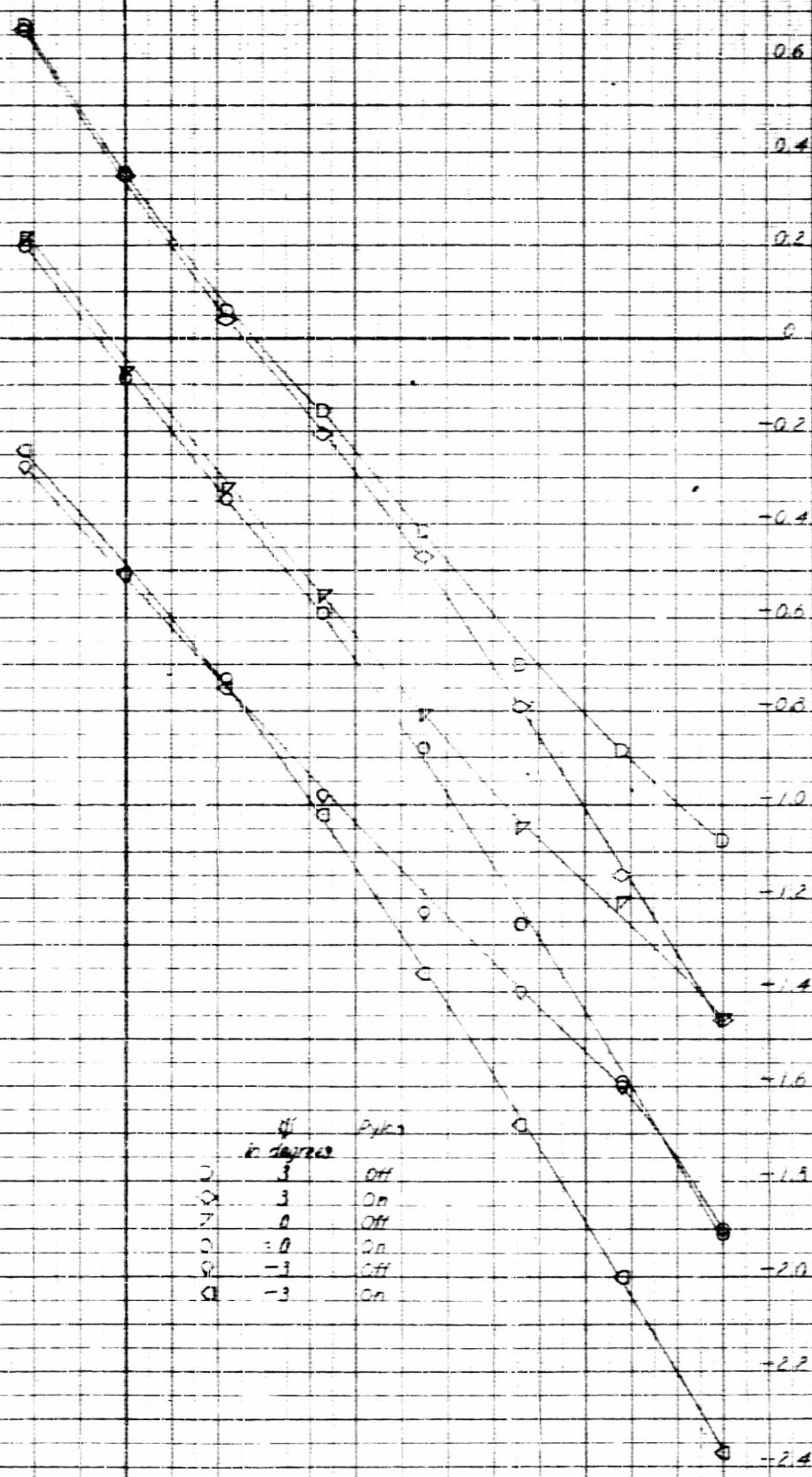
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11-210-000-000

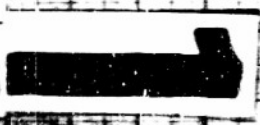
11-210-000-000

$\alpha$  in degrees



$\alpha$	$C_L$	Notes
0	3	Off
0	3	On
0	0	Off
0	0	On
0	-1	Off
0	-3	On

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2

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$\beta$	$\delta$	Pyke
0	3	Off
0	3	On
0	6	Off
0	6	On
0	-3	Off
0	-3	On

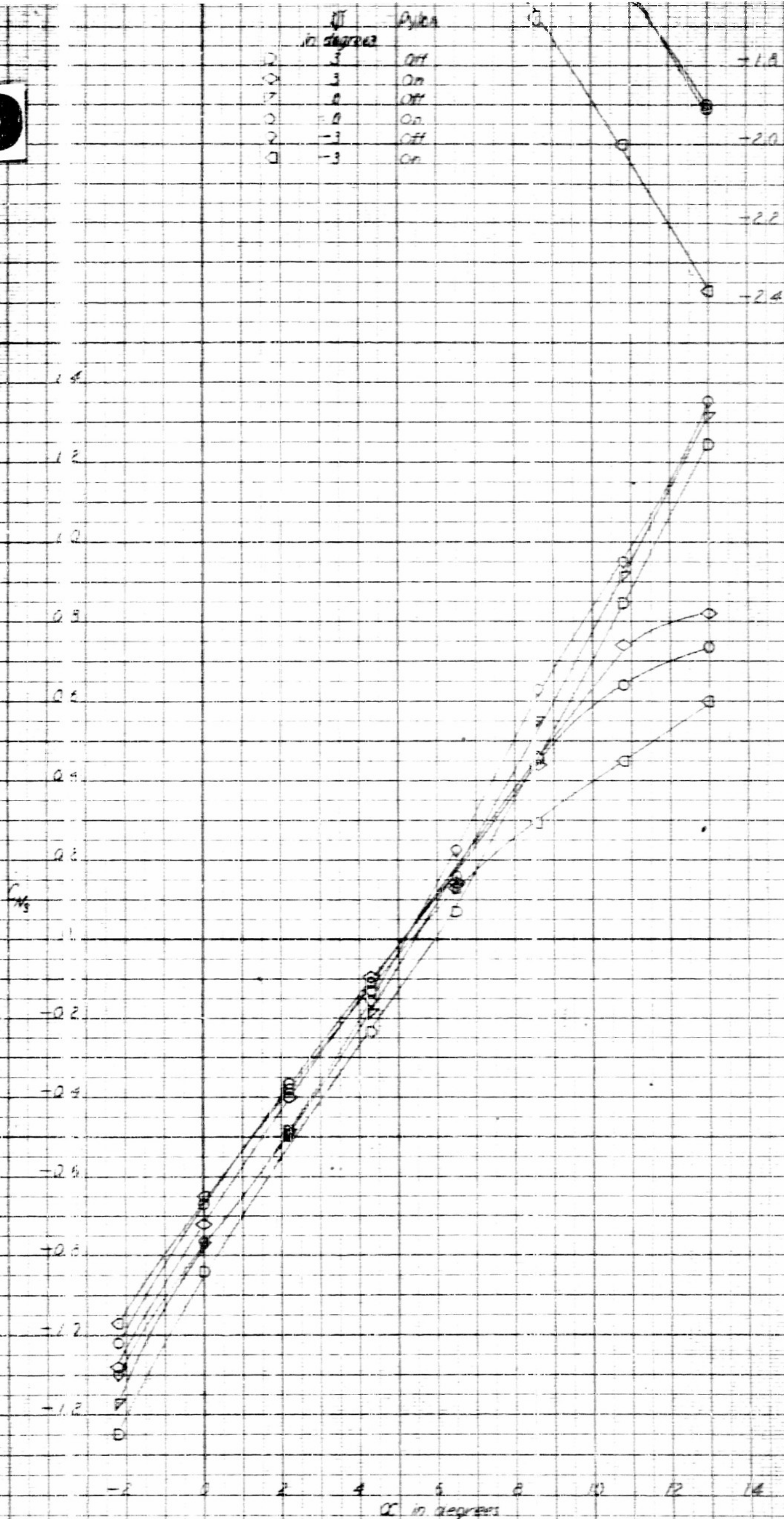


Figure 19-Effect of the Pyke and Airplane Yaw on the Aerodynamic Characteristics of a 0.17-Size Model X-40M-N-4 Cruise Missile in the Proximity of a 0.17-Size Model F-40M Airplane at the 0.5 Mach Station  
(1)  $z=0$  Inch,  $x=0$  Inch,  $\beta=0^\circ$ ,  $\delta=0^\circ$

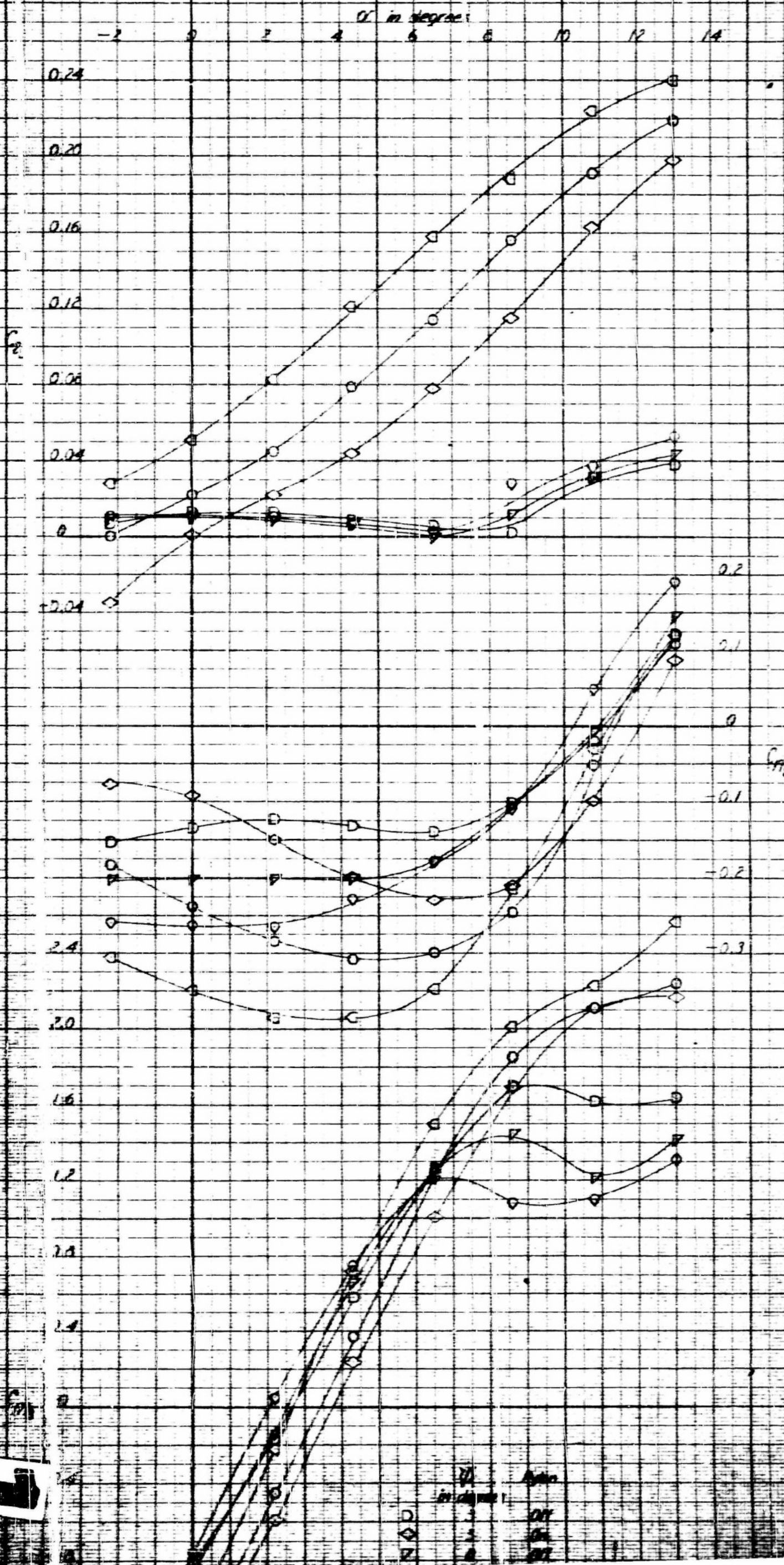
FIGURE 19 a

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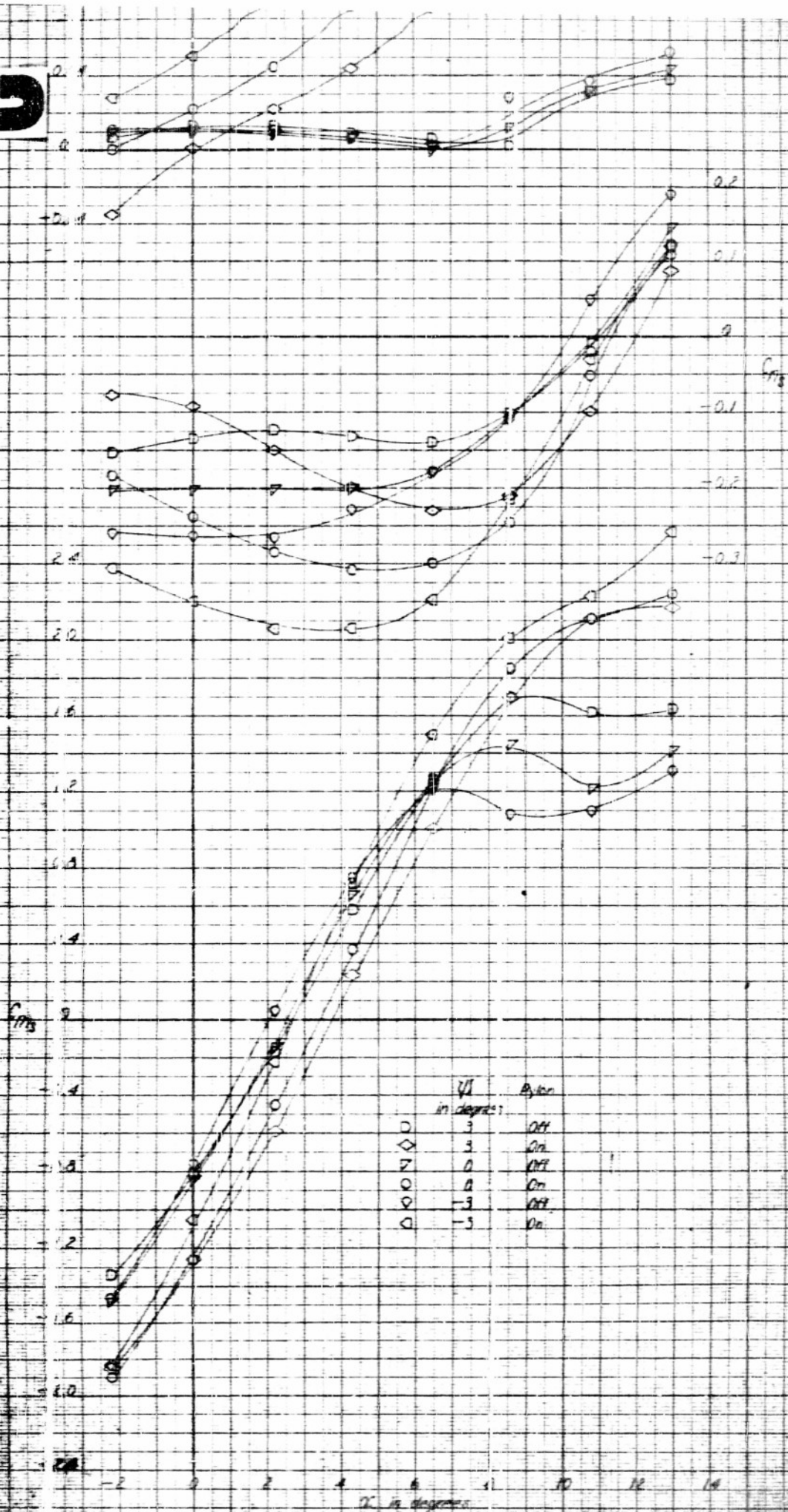
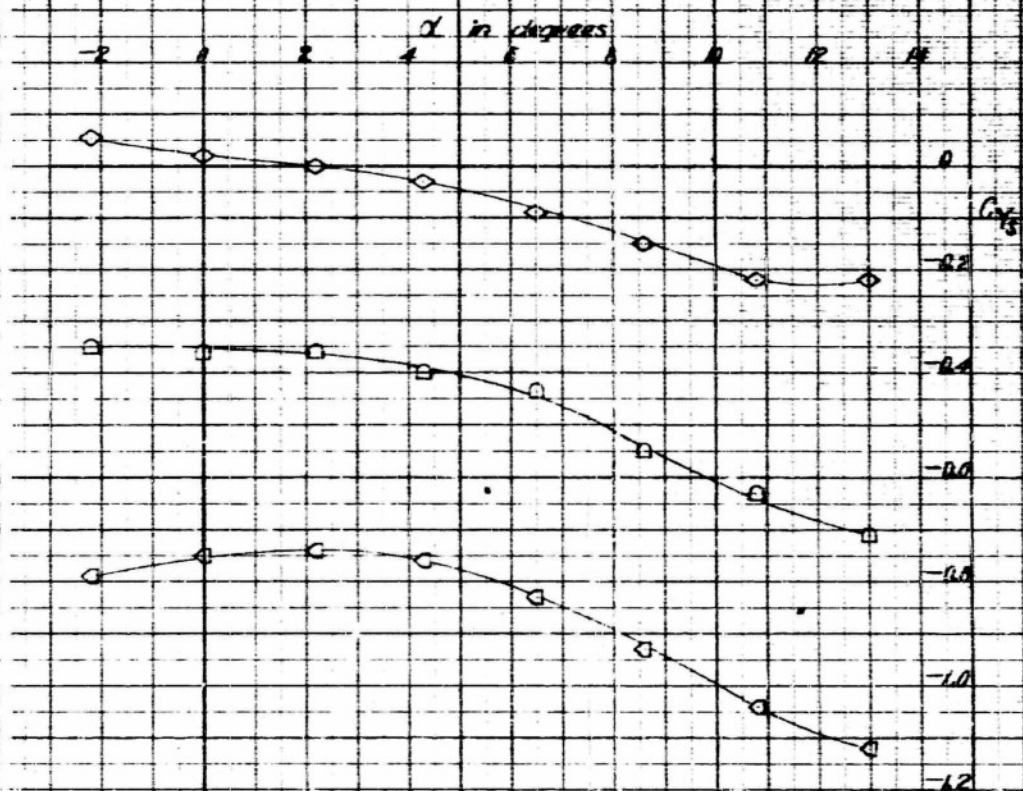


Figure B3/Confidential  
(a) Continued

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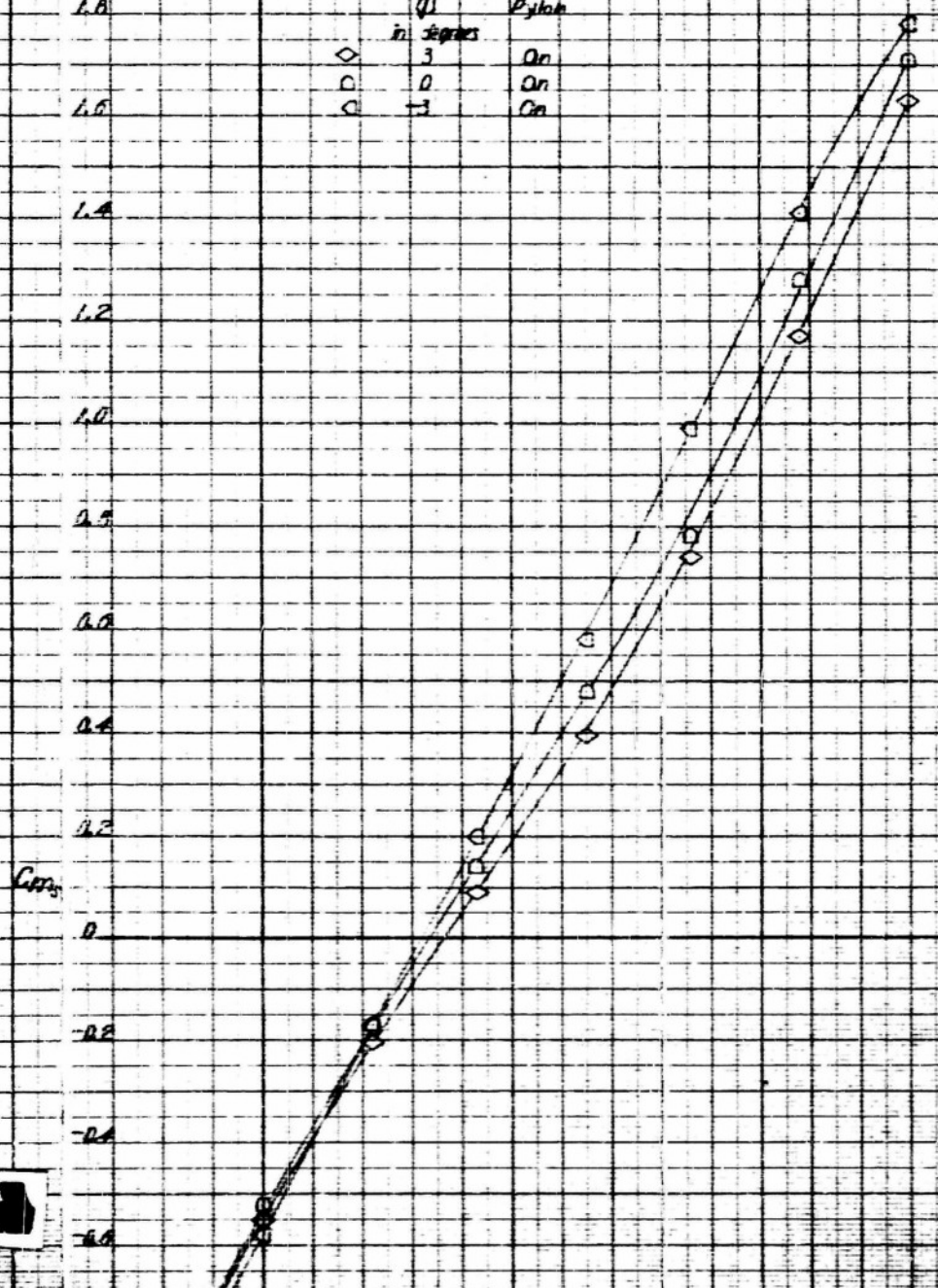
EG 21 Dec 55

MEM 864



	$\psi$ in degrees	Pylon
$\diamond$	3	On
$\square$	0	On
$\circ$	-3	On

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2

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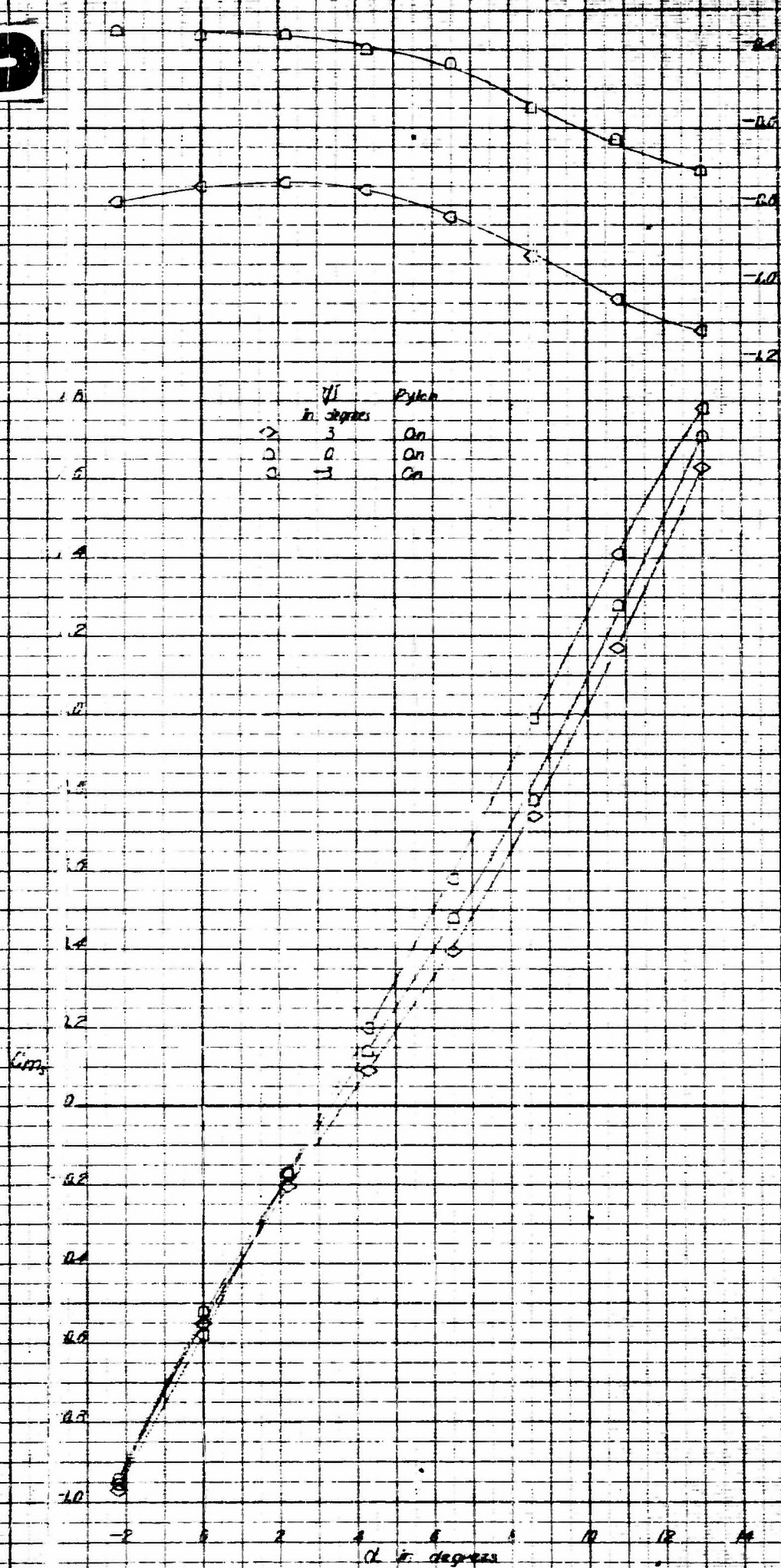


Figure 19 (continued)

(b)  $z = 2.04$  inches,  $x = 18.36$  inches,  $\theta_1 = 7^\circ$ ,  $\theta_2 = 0^\circ$

FIGURE 19 b

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FIGURE 10 (continued)

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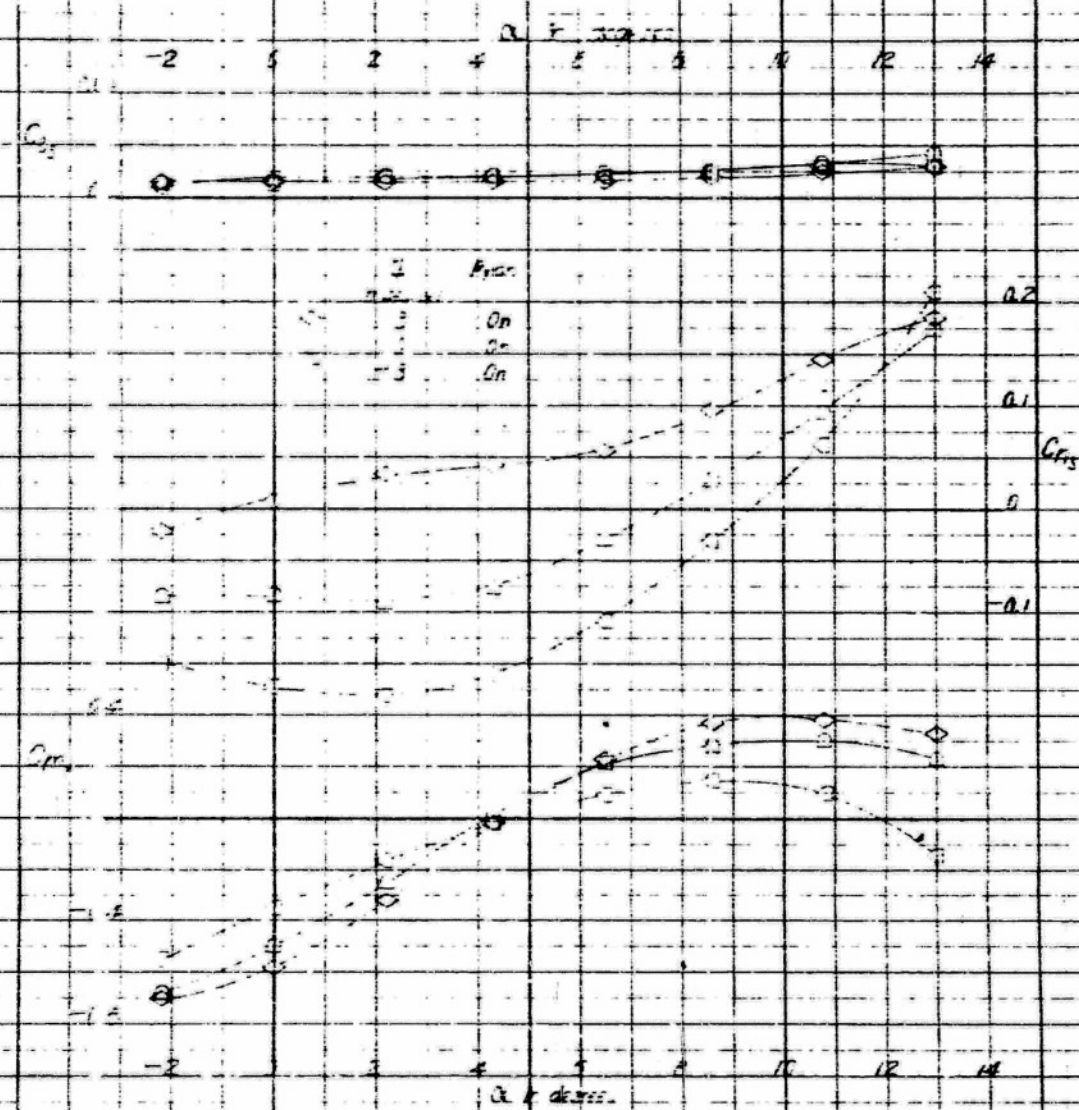
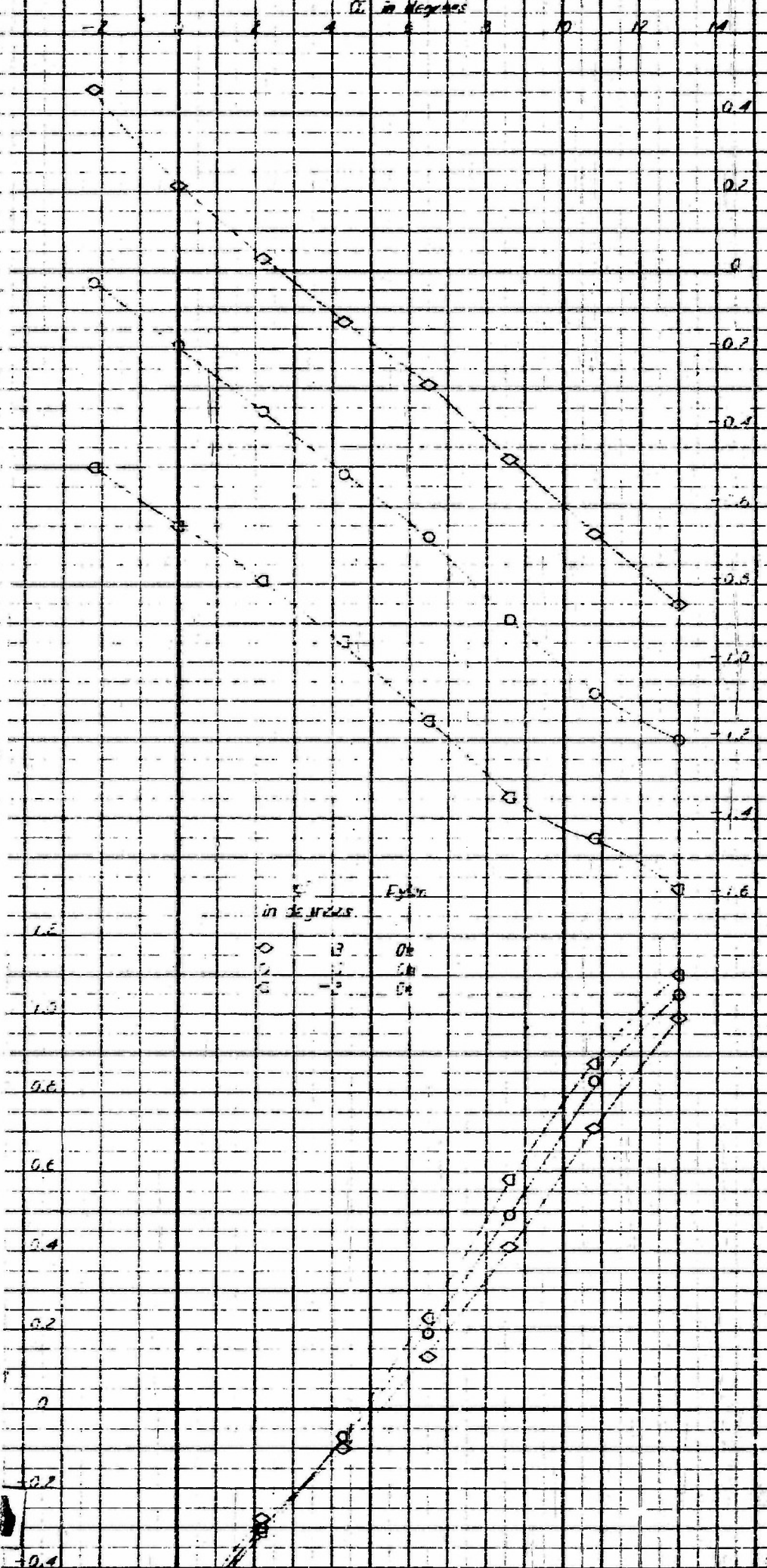


FIGURE 10 (continued)  
(a) (continued)

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$\alpha$  in degrees



1000000000

2

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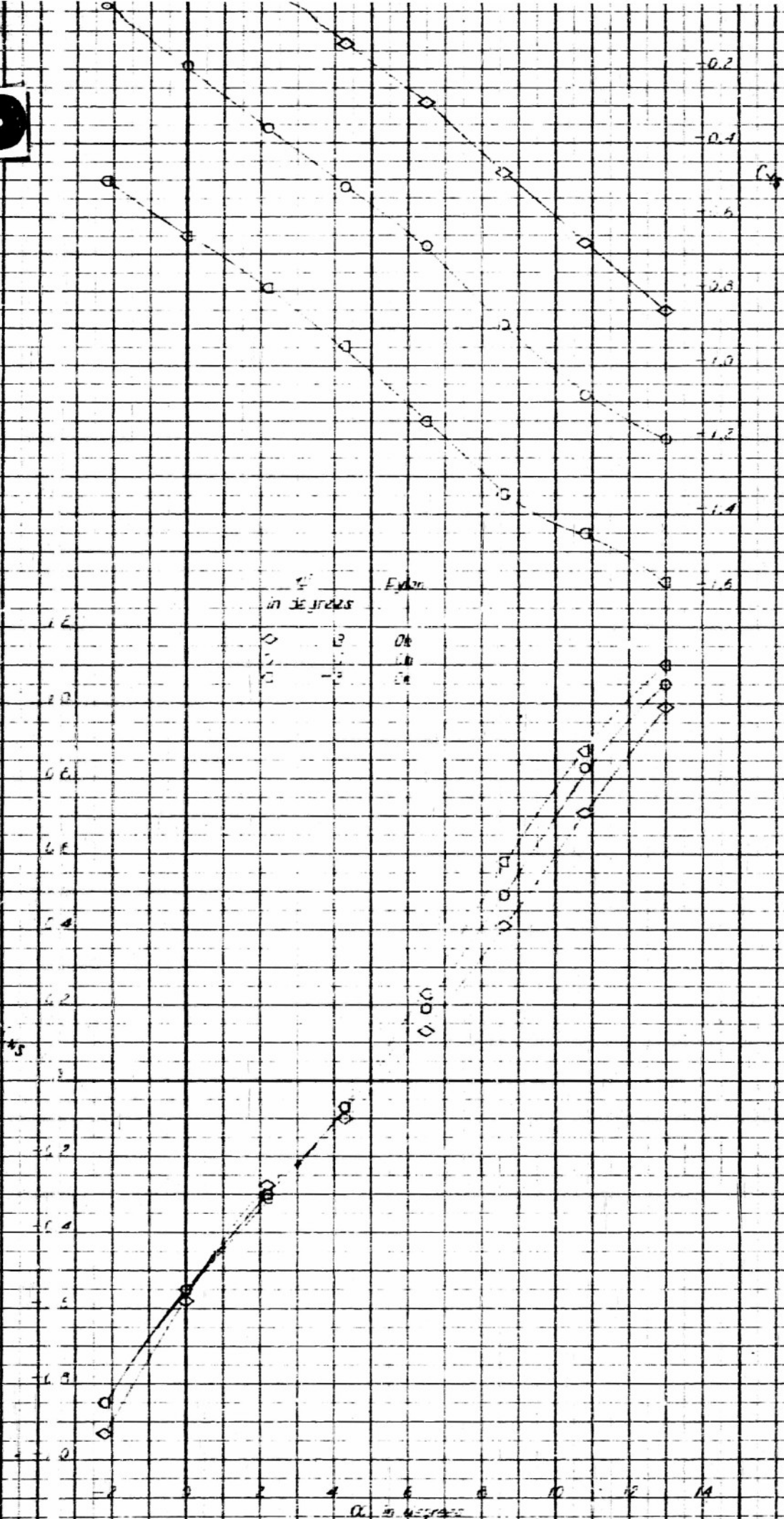


FIGURE 19C

Figure 19 (continued)  
 $(c) z = 4.661 \text{ inches}, x = 0.1 \text{ inch}, \theta_s = 0, V_s = 9$

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FIGURE 19 (continued)

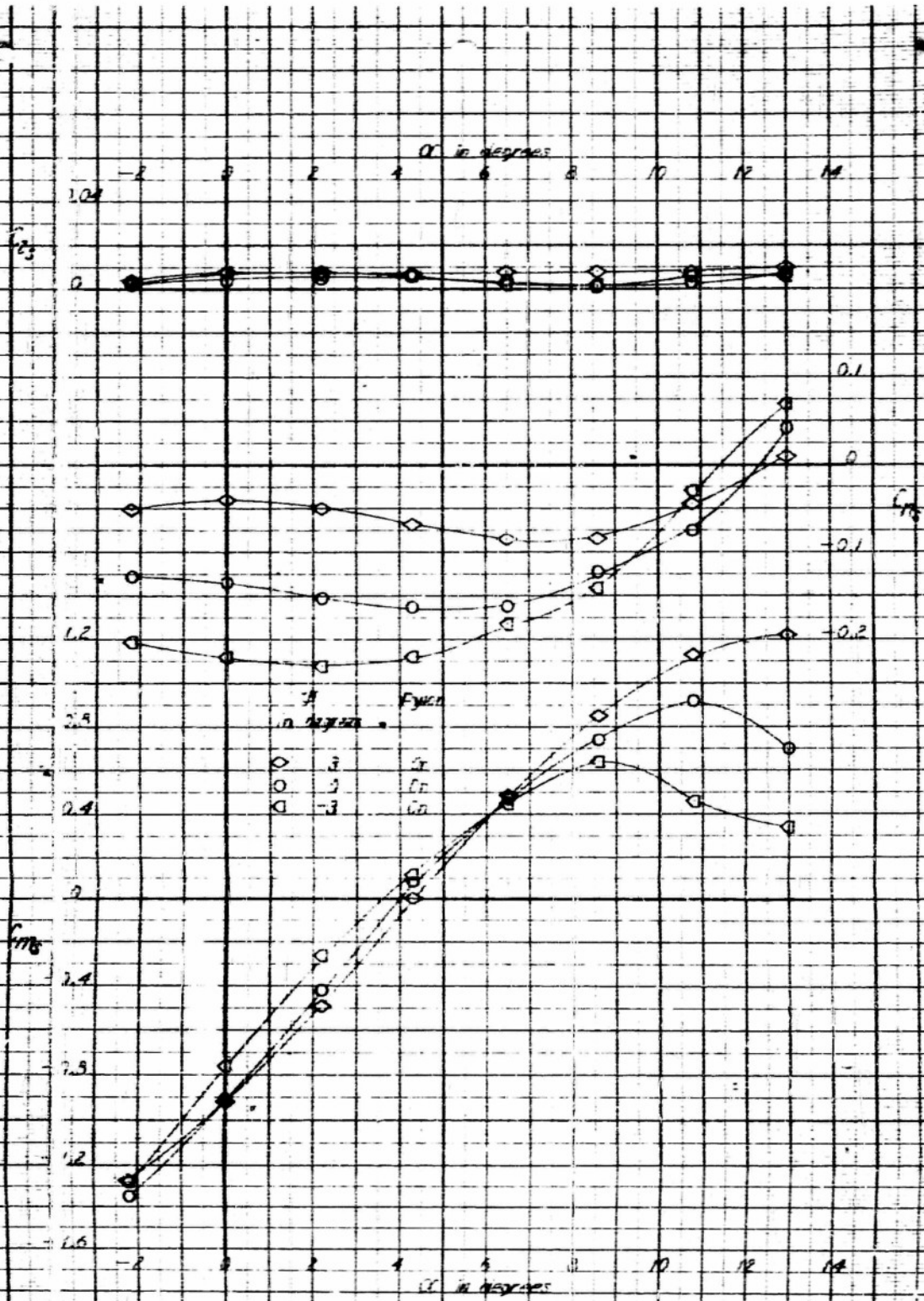
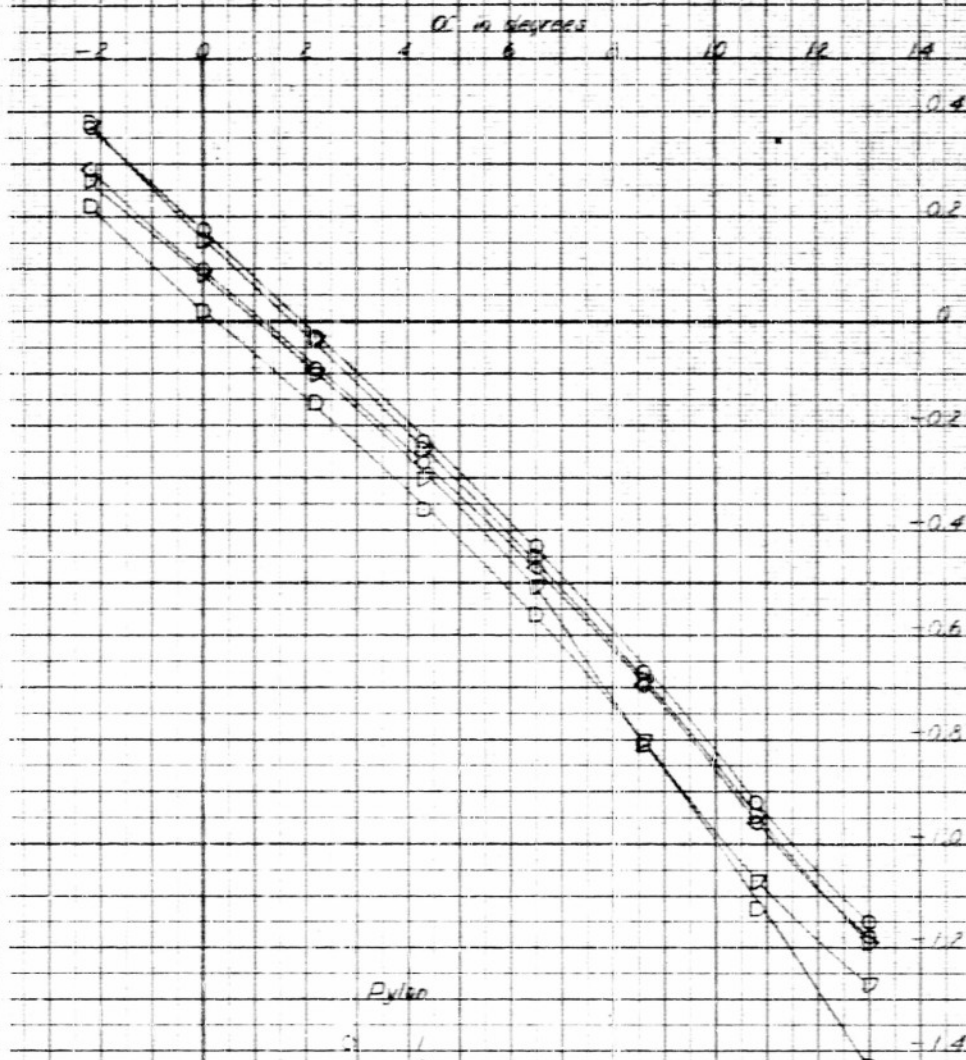


Figure 19 (continued)  
(c) Concluded

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0.140054

0.140054



Pylon

- 1
- 2
- 3
- 4
- 5

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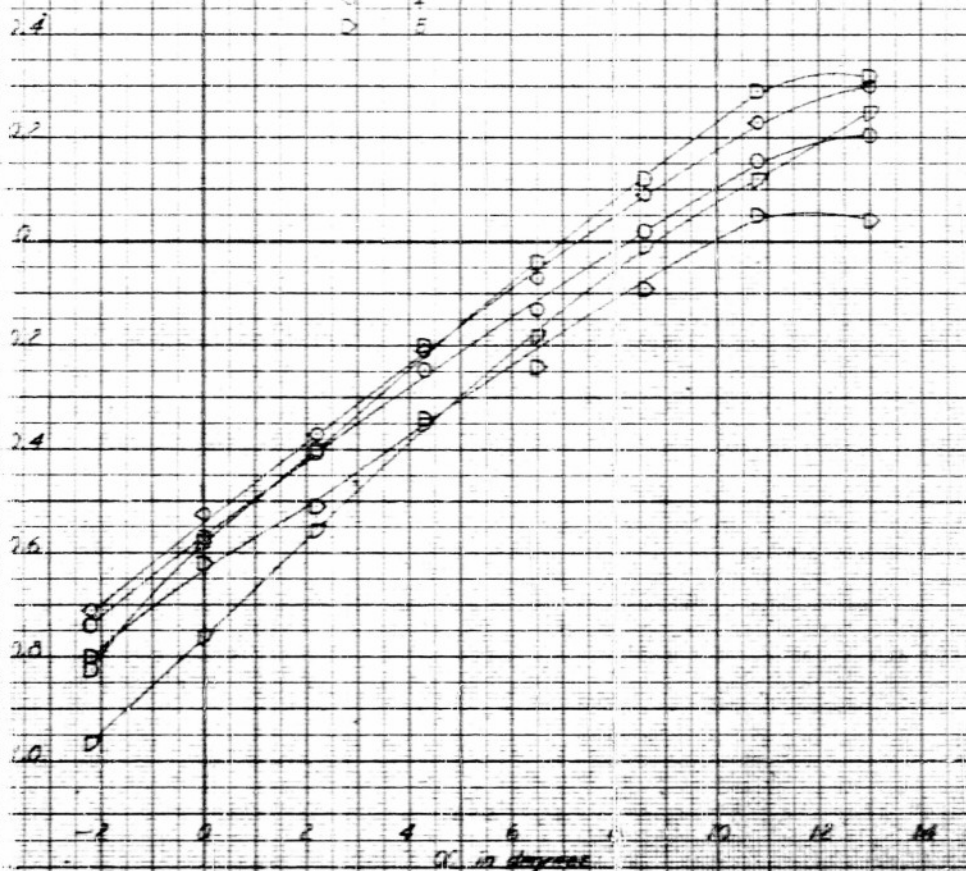


Figure 80 - Effect of Several Pylon Configurations on the Aerodynamic Characteristics of the X-47B Aircraft



2

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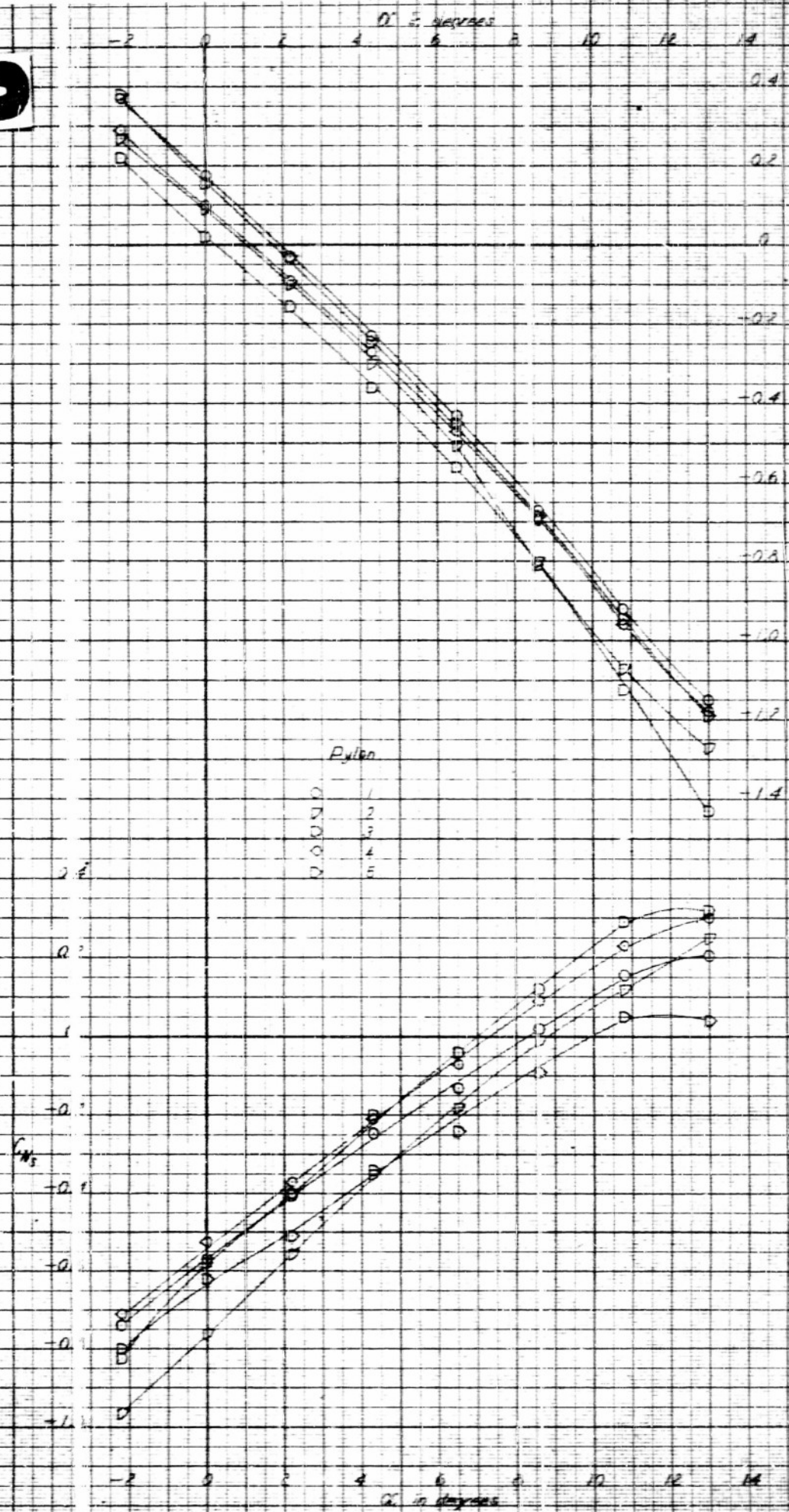


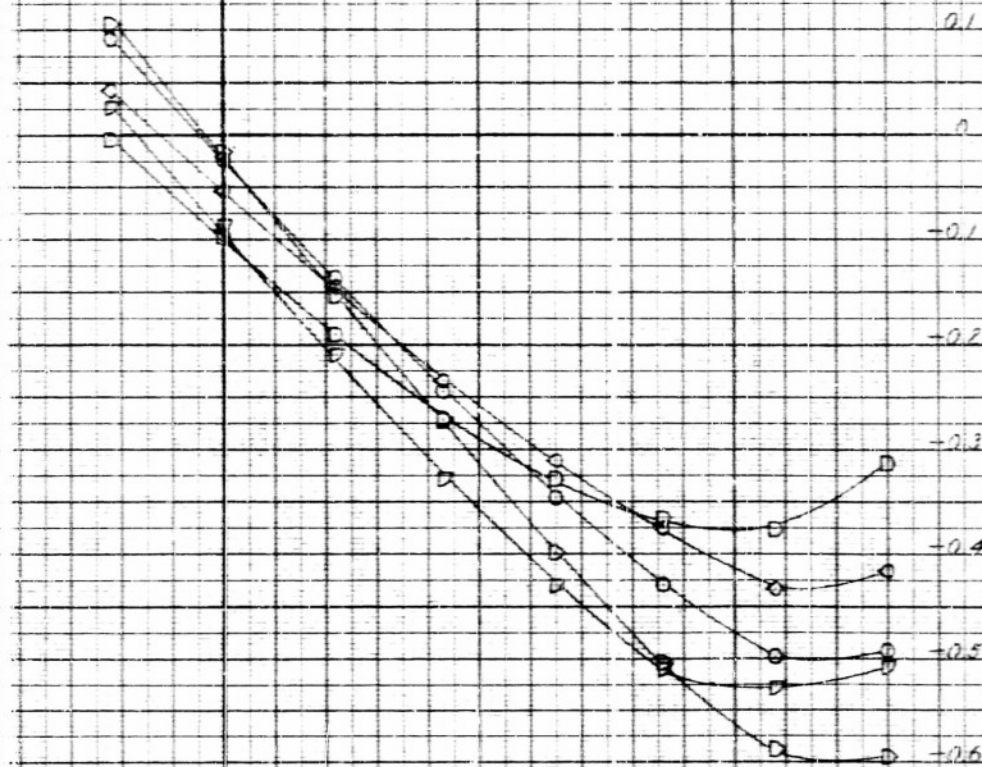
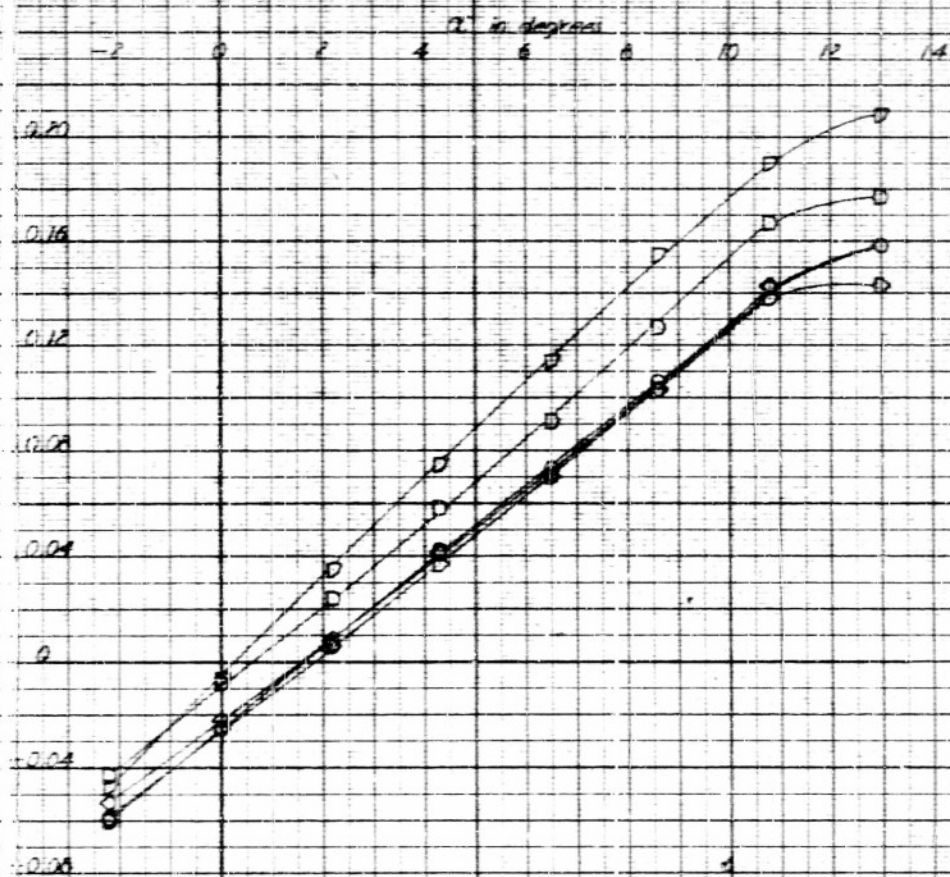
Figure 20 - Effect of Several Pylon Configurations on the Aerodynamic Characteristics of a 0.075-Scale Model X-400-11-4 Cruise Missile Mounted on a 0.075-Scale Model F-4D-1 Airplane (at Forward Station,  $M=0.7$ )

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Pyke

1	1
2	2
3	3
4	4
5	5



2

CONTINUED

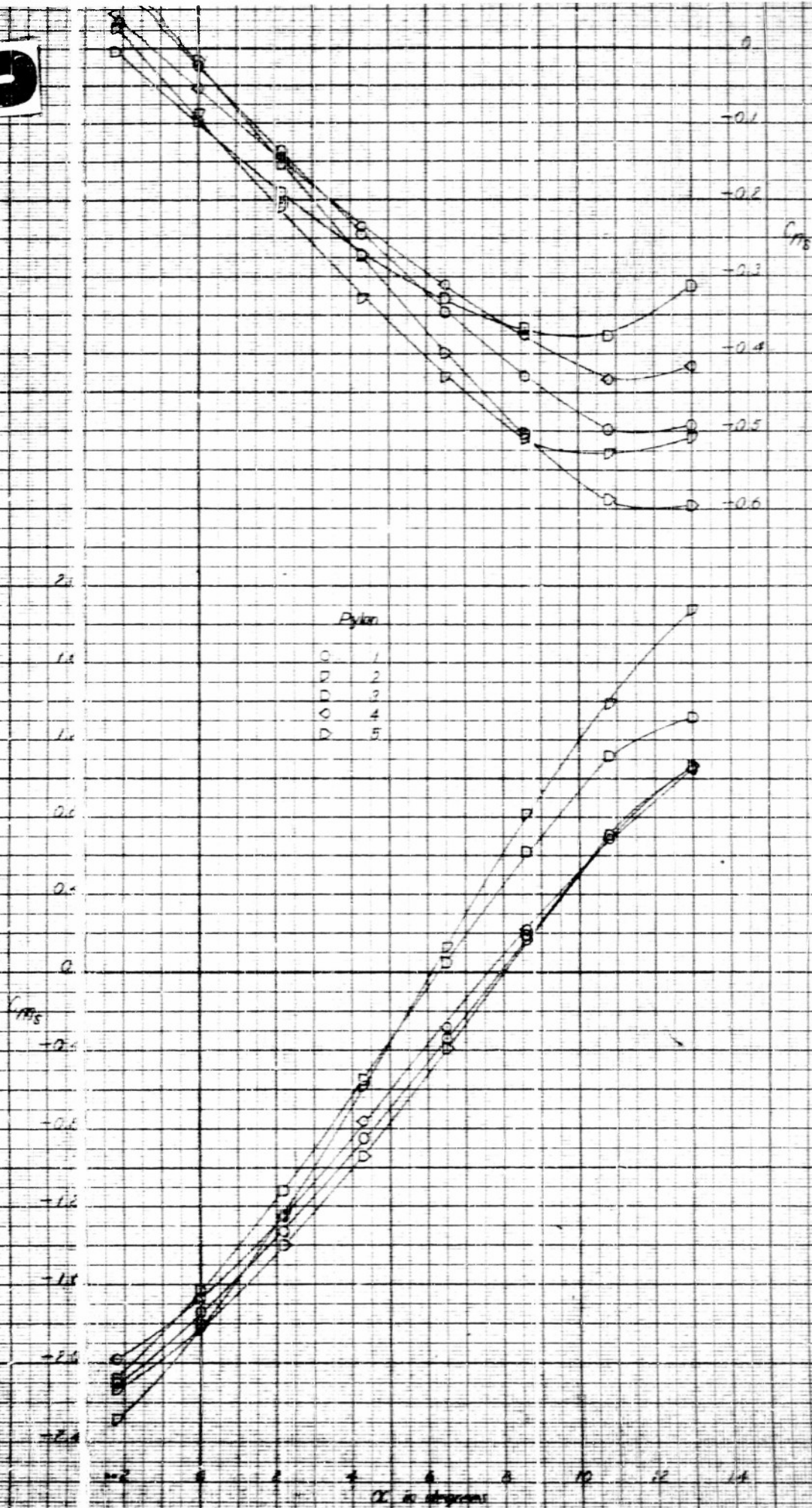


Figure 20 (continued)

(b) Concluded



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ALBUQUERQUE

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14

0.2  
0  
-0.2  
-0.4  
-0.6  
-0.8  
-1.0  
-1.2  
-1.4  
-1.6  
-1.8  
-2.0

$C_{y0}$

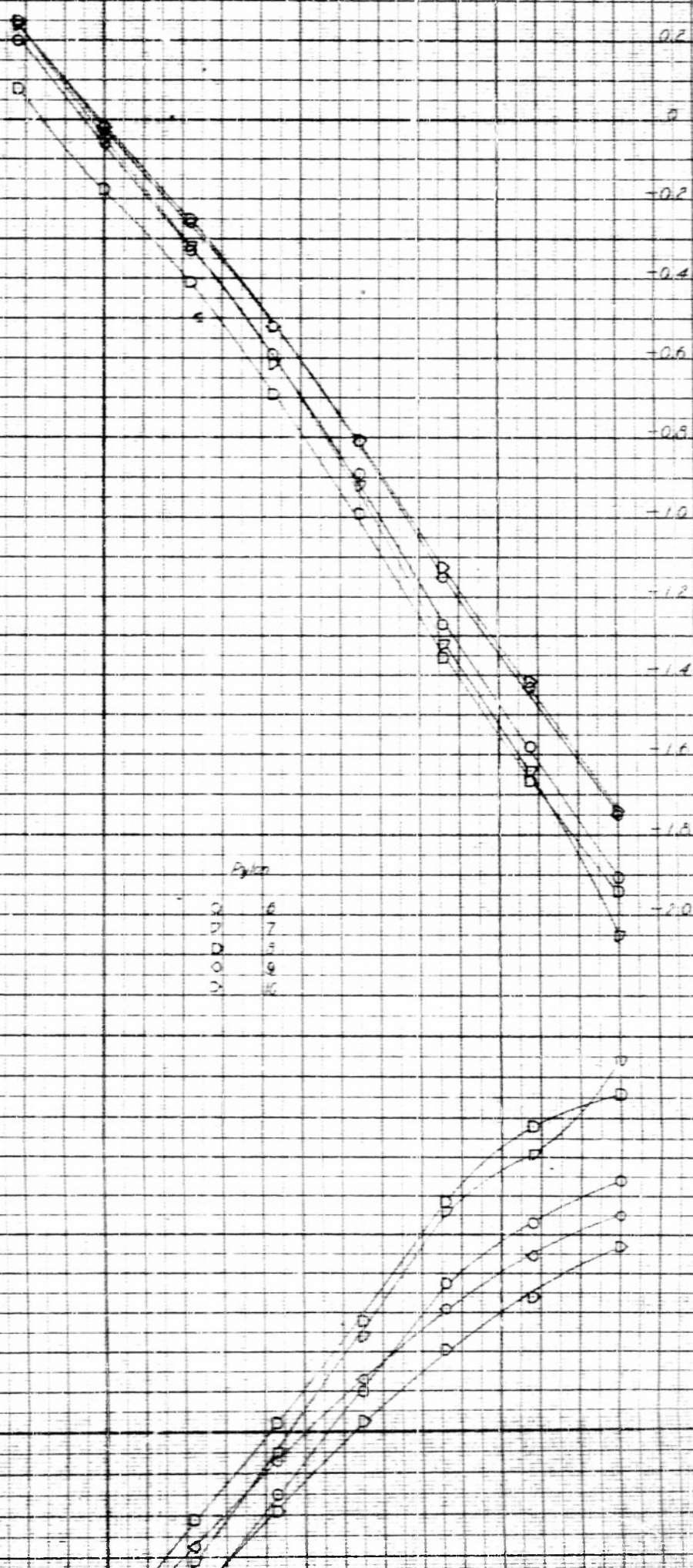
$P_{y0}$

0.2	6
0.4	7
0.6	8
0.8	9
1.0	10

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1.0  
0.8  
0.6  
0.4  
0.2  
0  
-0.2

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2

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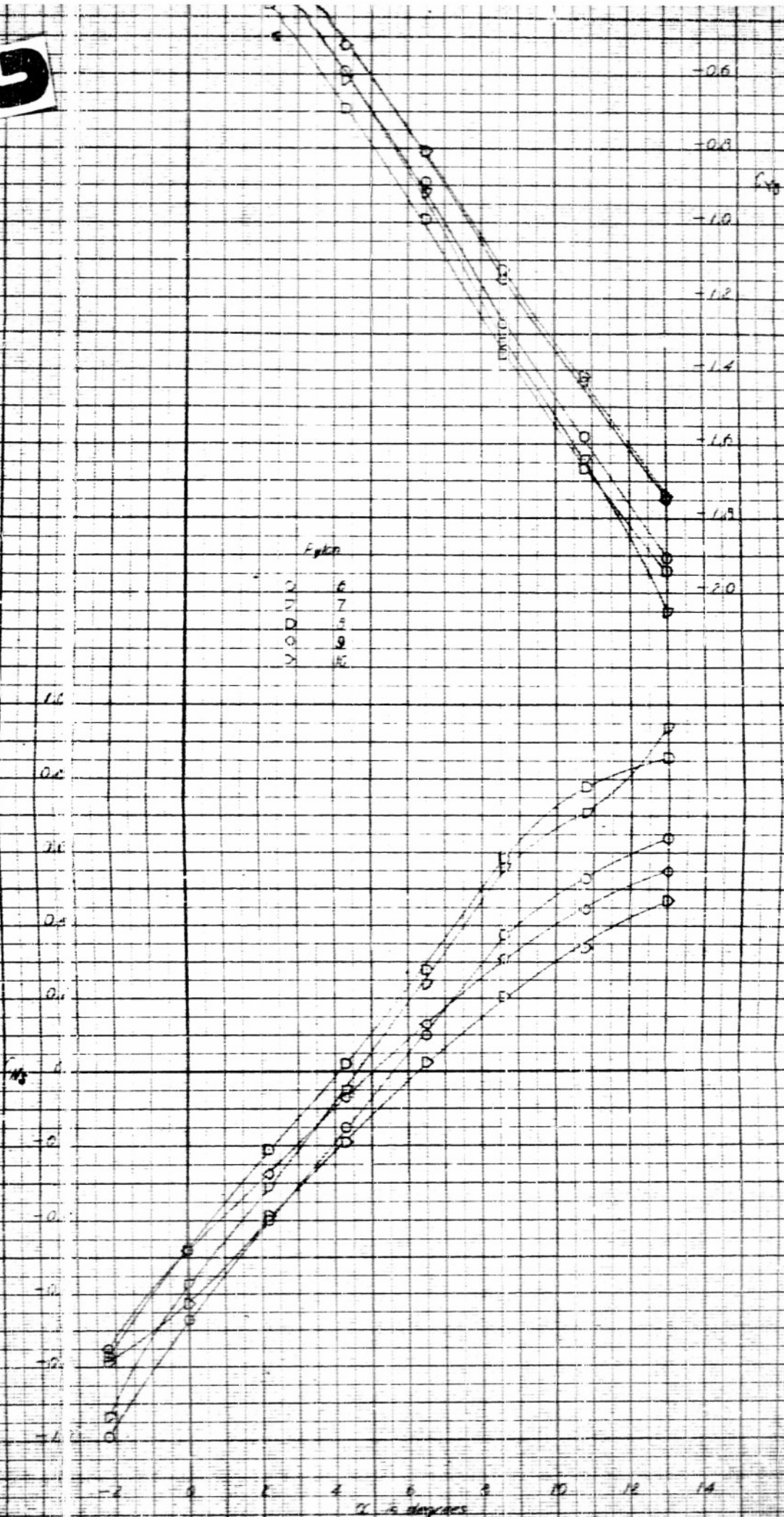
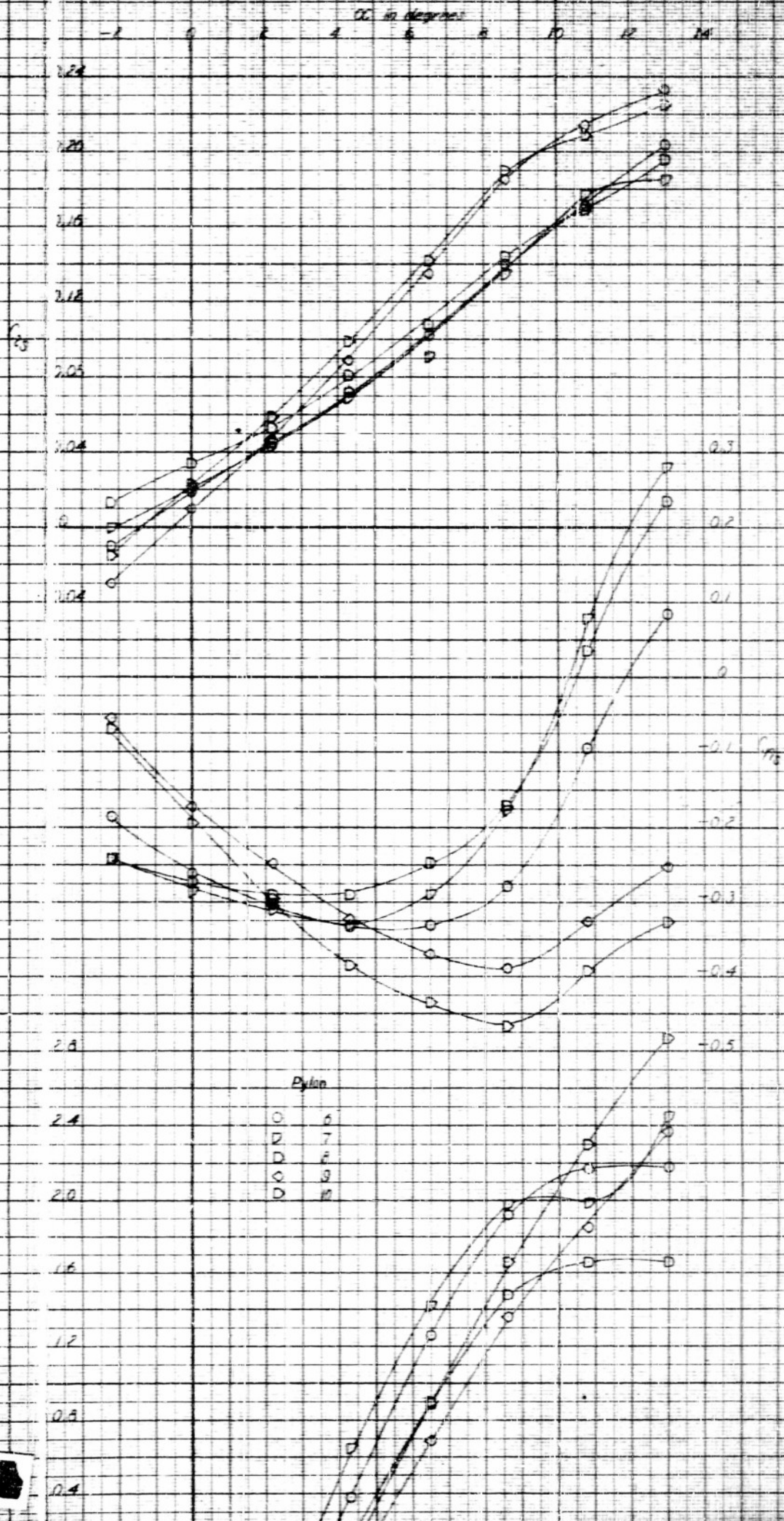


Figure 20 (Continued)  
 2. Outboard Station,  $V=0$

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2

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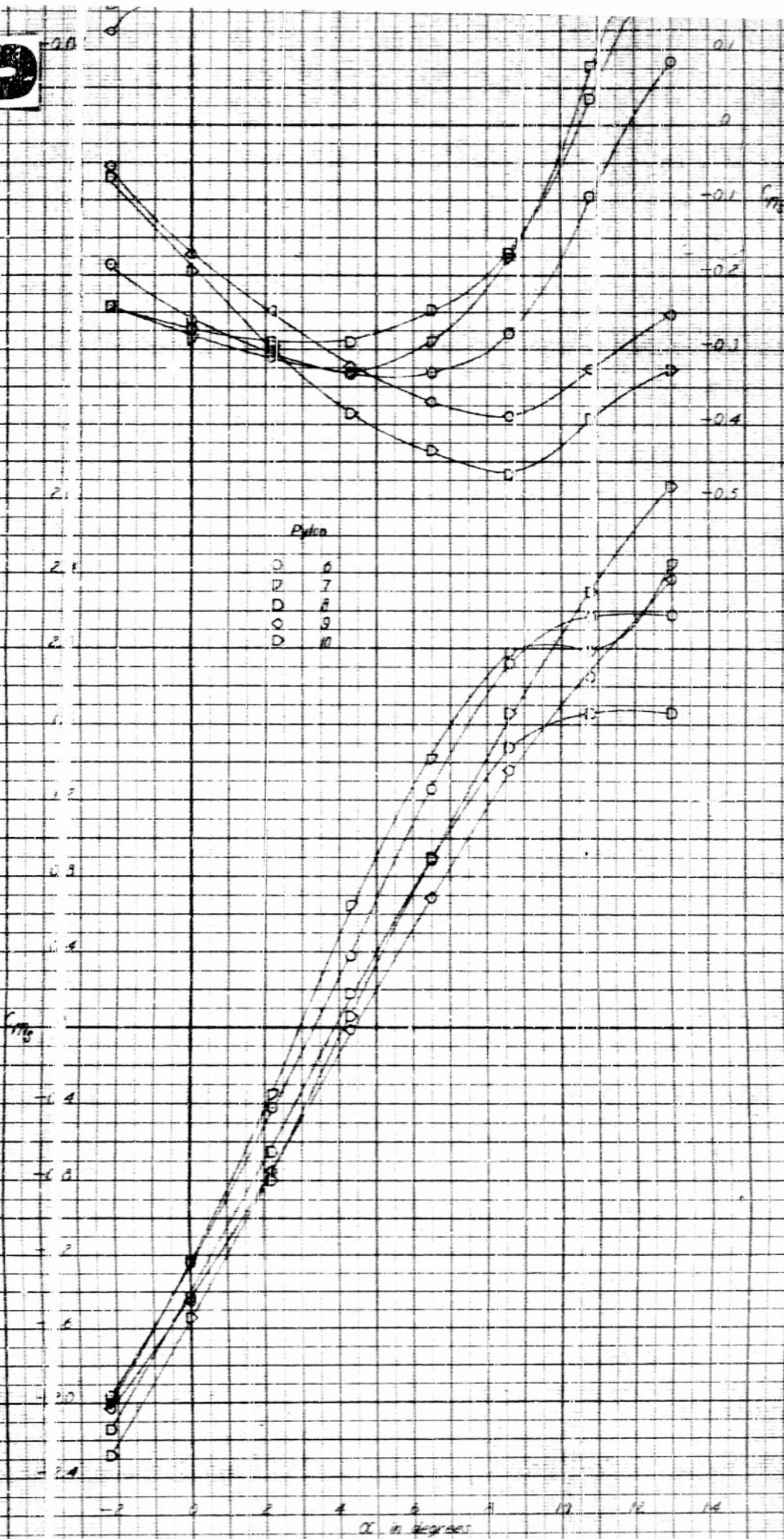


FIGURE 2.0 (Contd.)

Figure 2.0 (Continued)

(a) Continued

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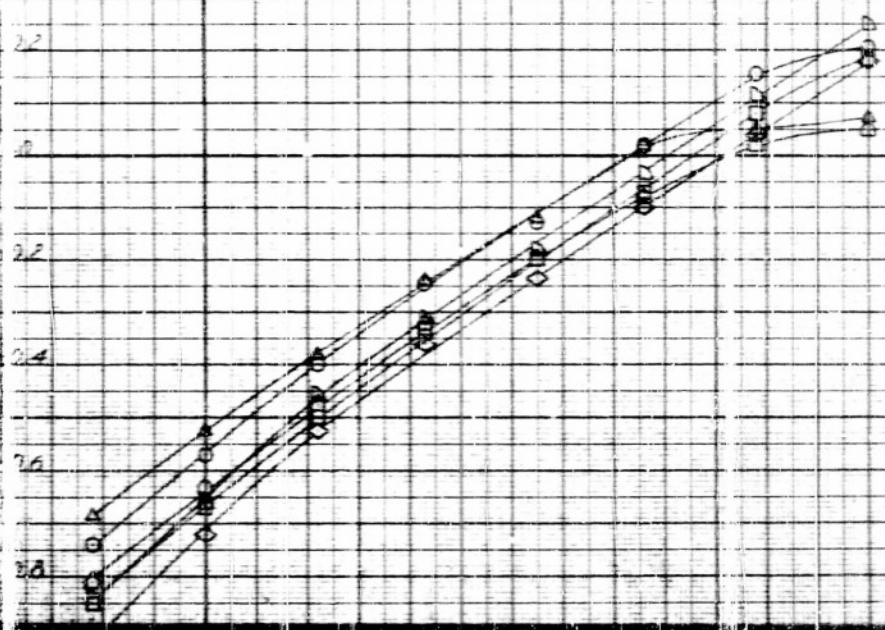
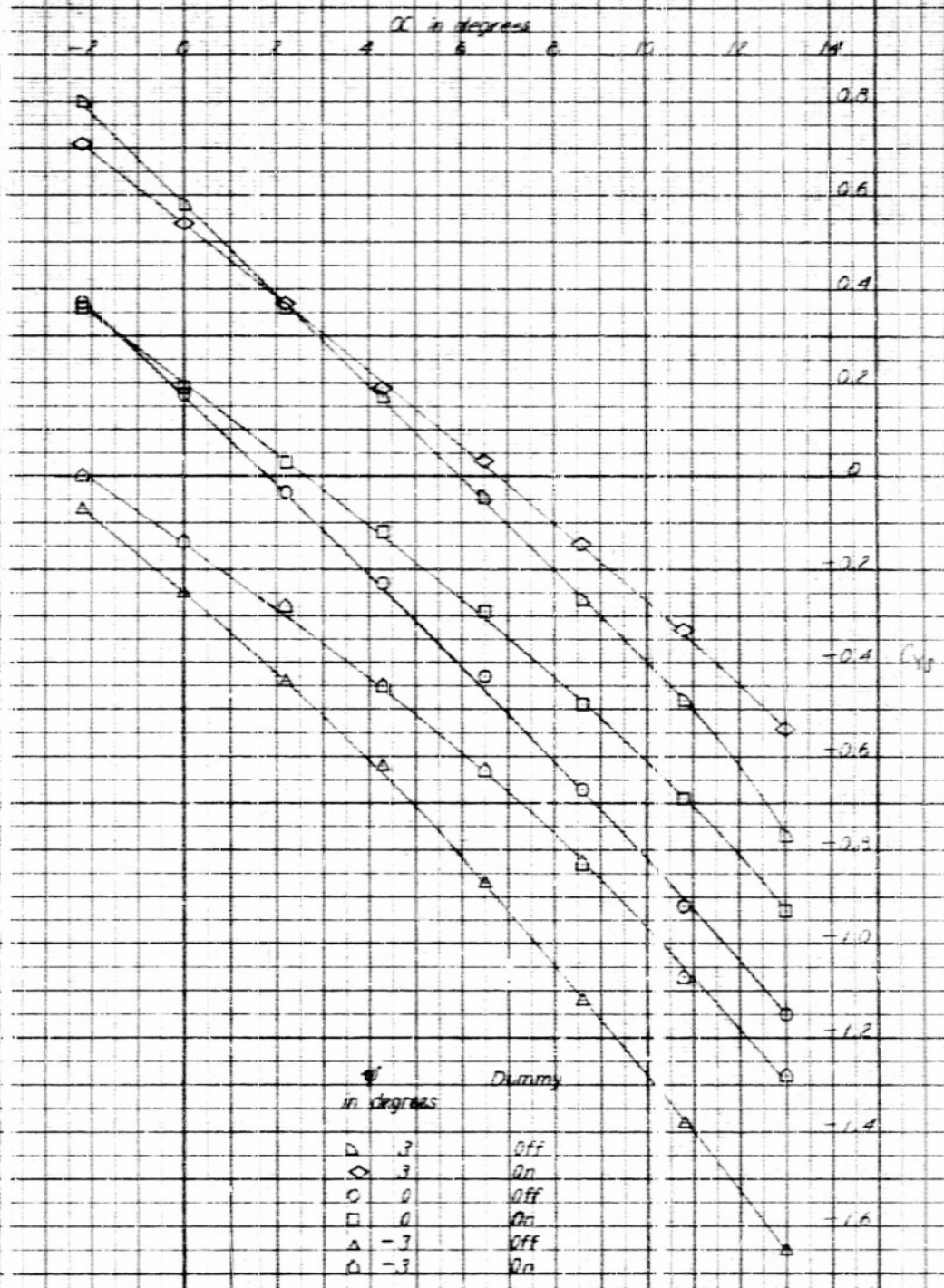
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2

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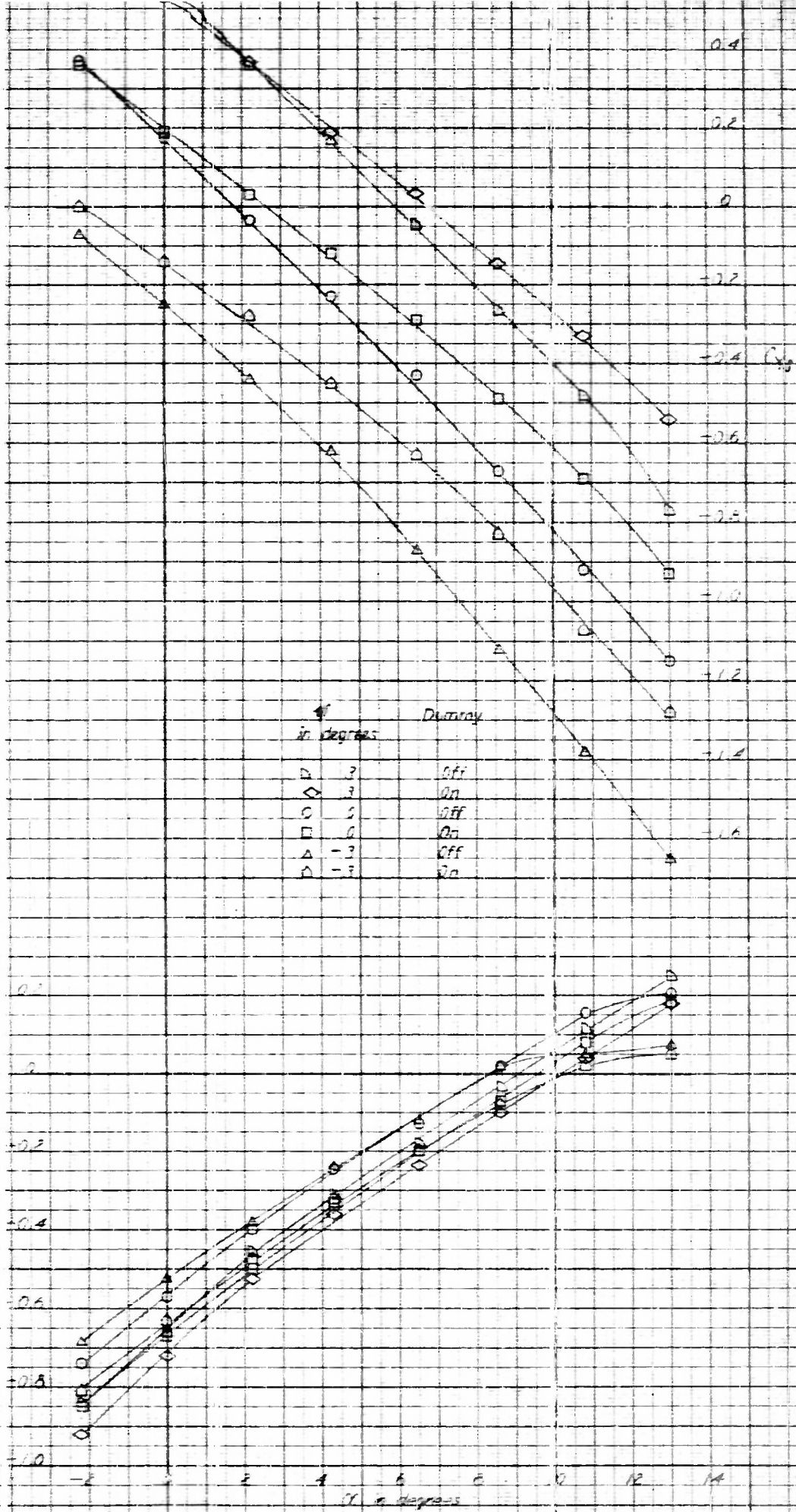


Figure 21 - Effect of Airplane Yaw and Dummy Missile on the Aerodynamic Characteristics of a Q17-Scale Model XAAM-N-4 Cruise Missile Mounted on a Q170-Scale Model F4D-1 Airplane  
(a) Tabbed Station, Pylon 1

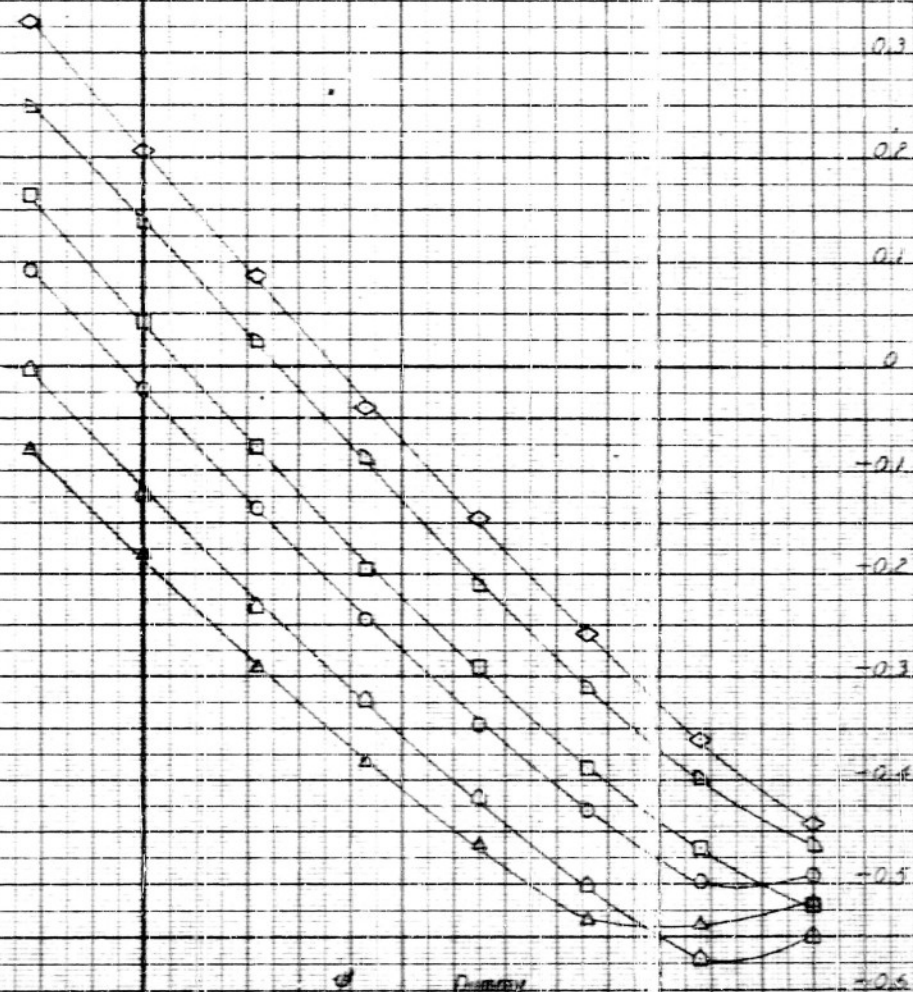
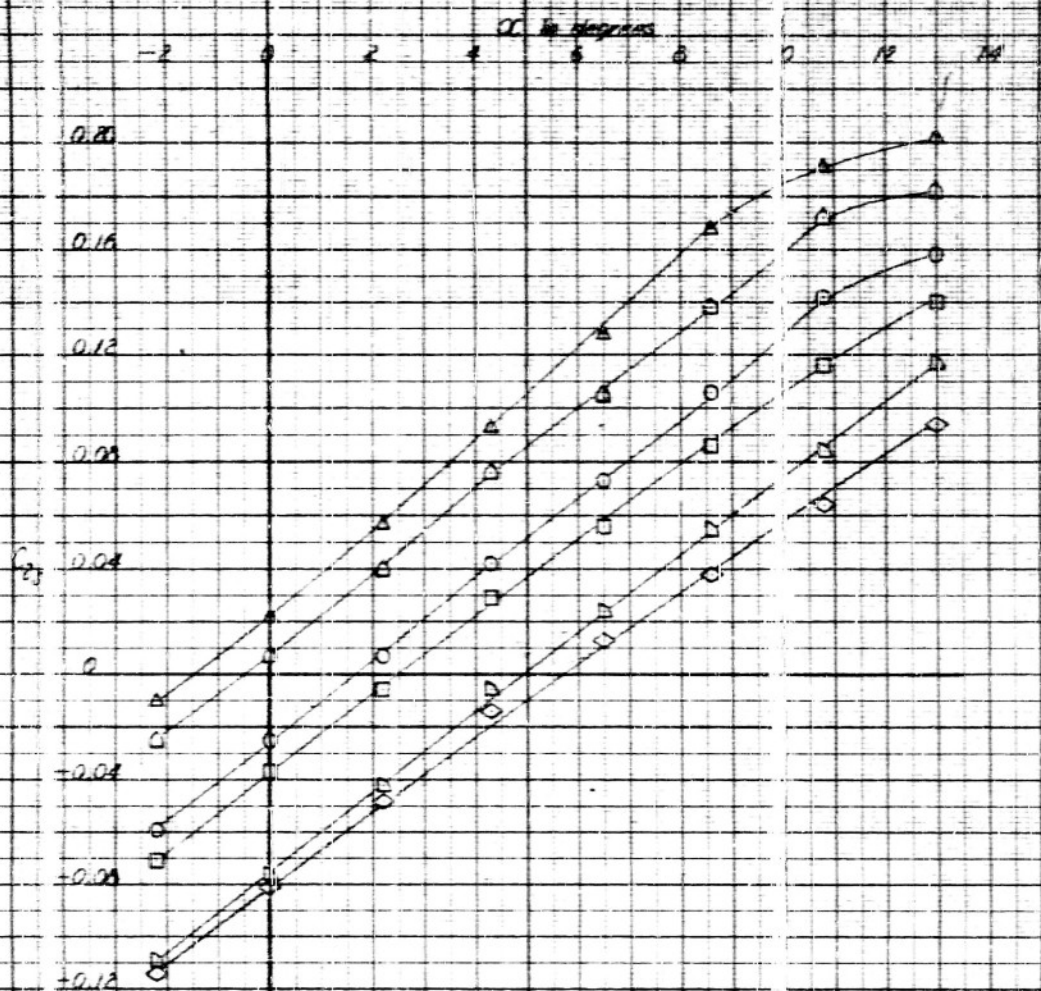
FIGURE 21a

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571160254

AERO 00024



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1



2

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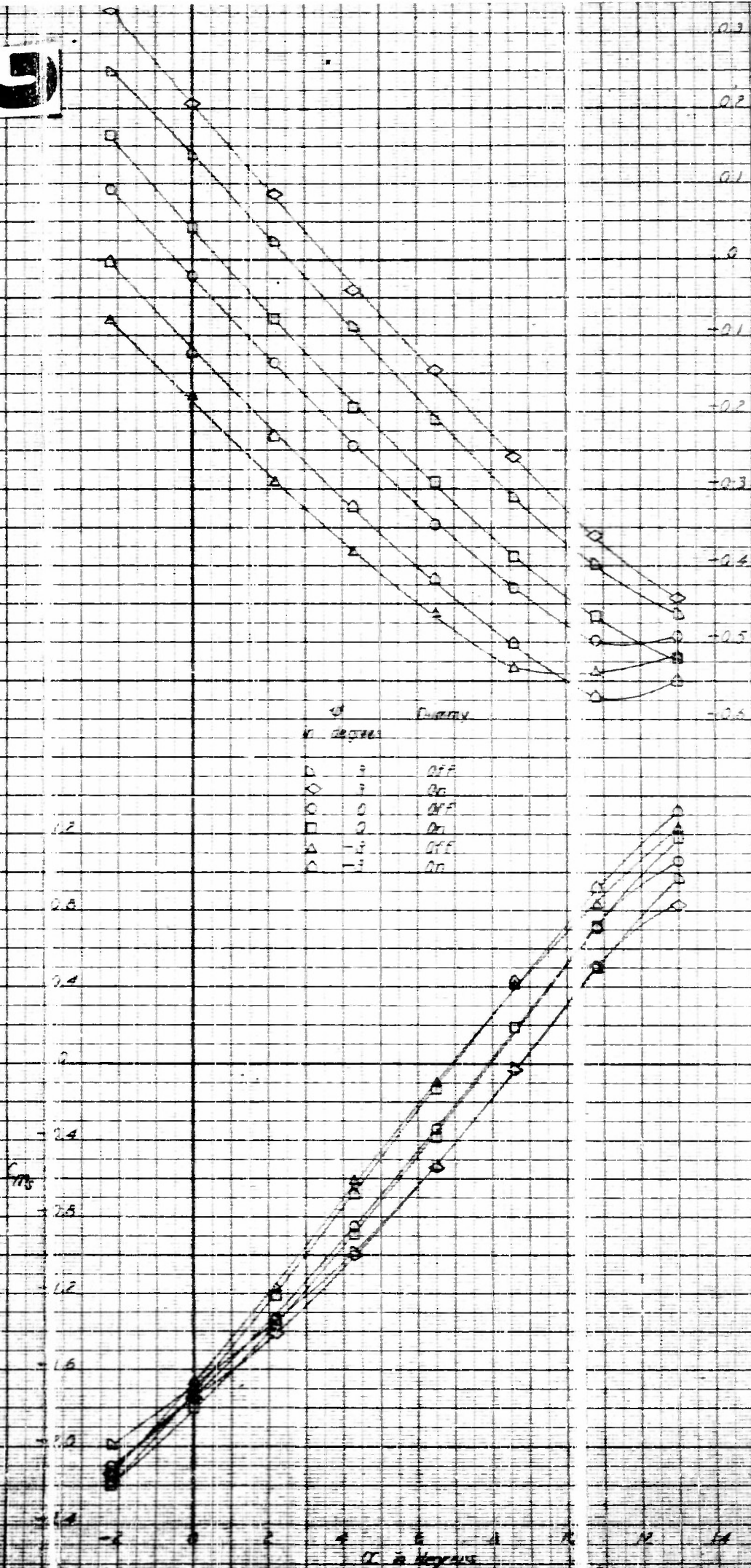


Figure 21 (Continued)  
to be continued

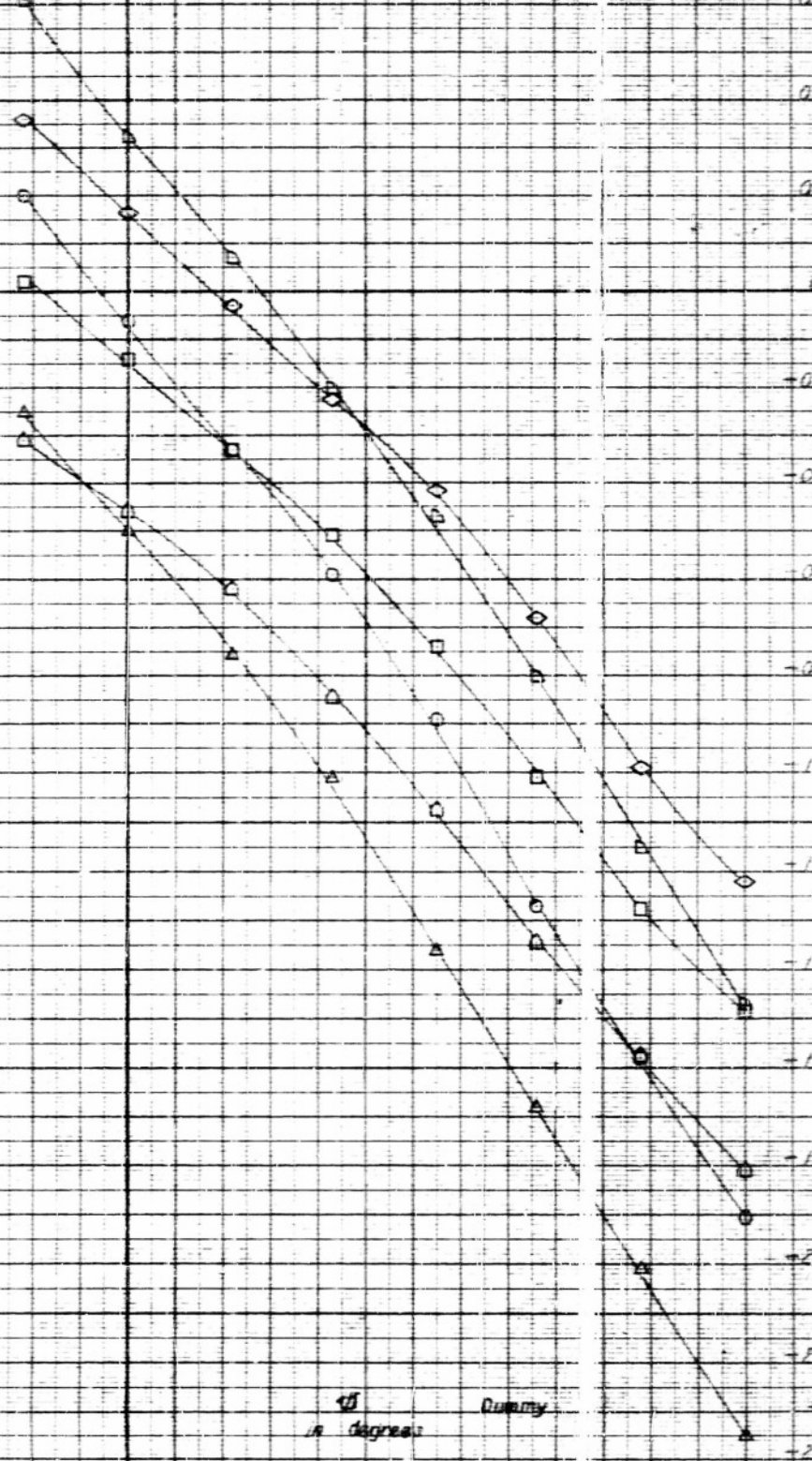
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1000000

1000000

$\alpha$  in degrees

-2 0 2 4 6 8 10 12 14



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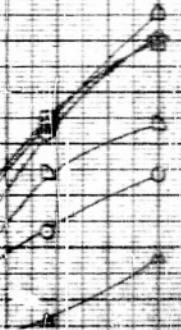
$\alpha$	in degrees	Summary
$\diamond$	3	Off
$\diamond$	3	On
$\circ$	0	Off
$\square$	0	On
$\Delta$	-3	Off
$\Delta$	-3	On

1.0

0.8

0.6

0.4





# 2

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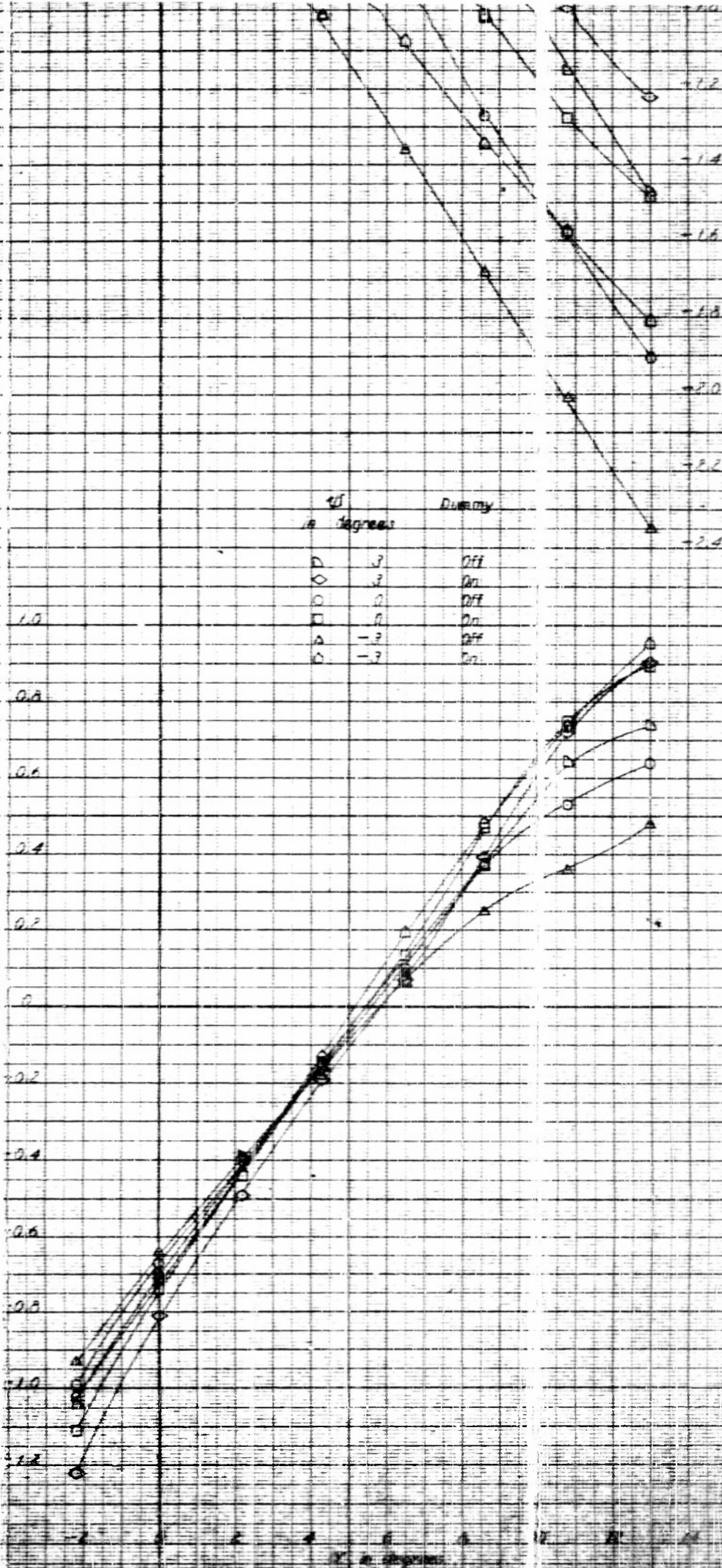


Fig. 2 (Continued)

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$C_{L\beta}$

$\alpha$  in degrees

0.28

0.26

0.18

0.12

0.08

0.04

0

-0.04

-0.4

-0.6

-0.8

-1.0

-1.2

-1.4

-1.6

-1.8

12

14

0.1

0

-0.1

-0.2

-0.3

-0.4

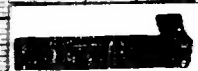
-0.5

$\alpha$  in degrees

Curry

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12

0.1  
0.2  
0.3  
0.4  
0.5  
0.6  
0.7  
0.8  
0.9  
1.0  
1.1  
1.2



2

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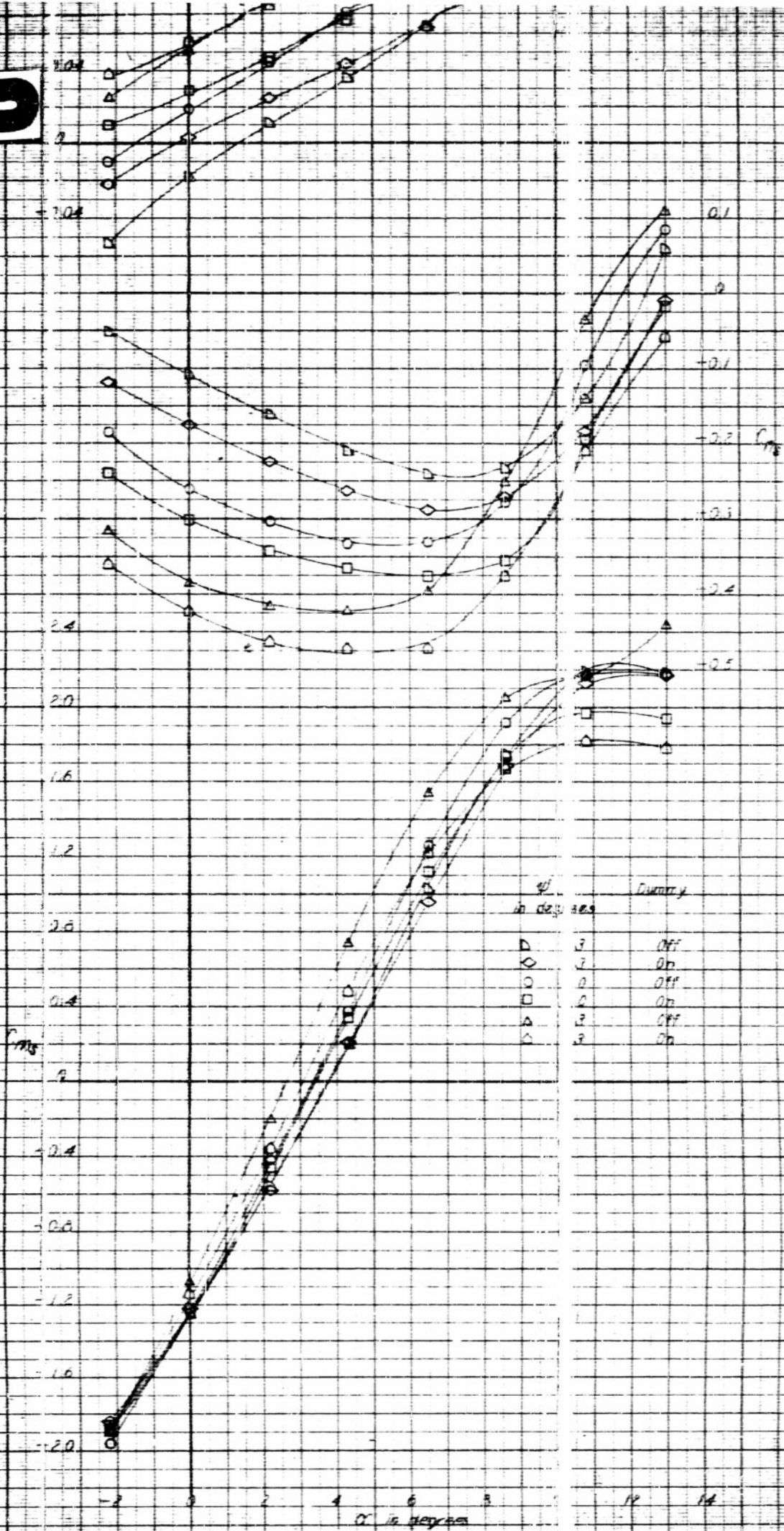


Figure 21 (Concluded)

(b) Concluded

FIGURE 21b (Contd.)

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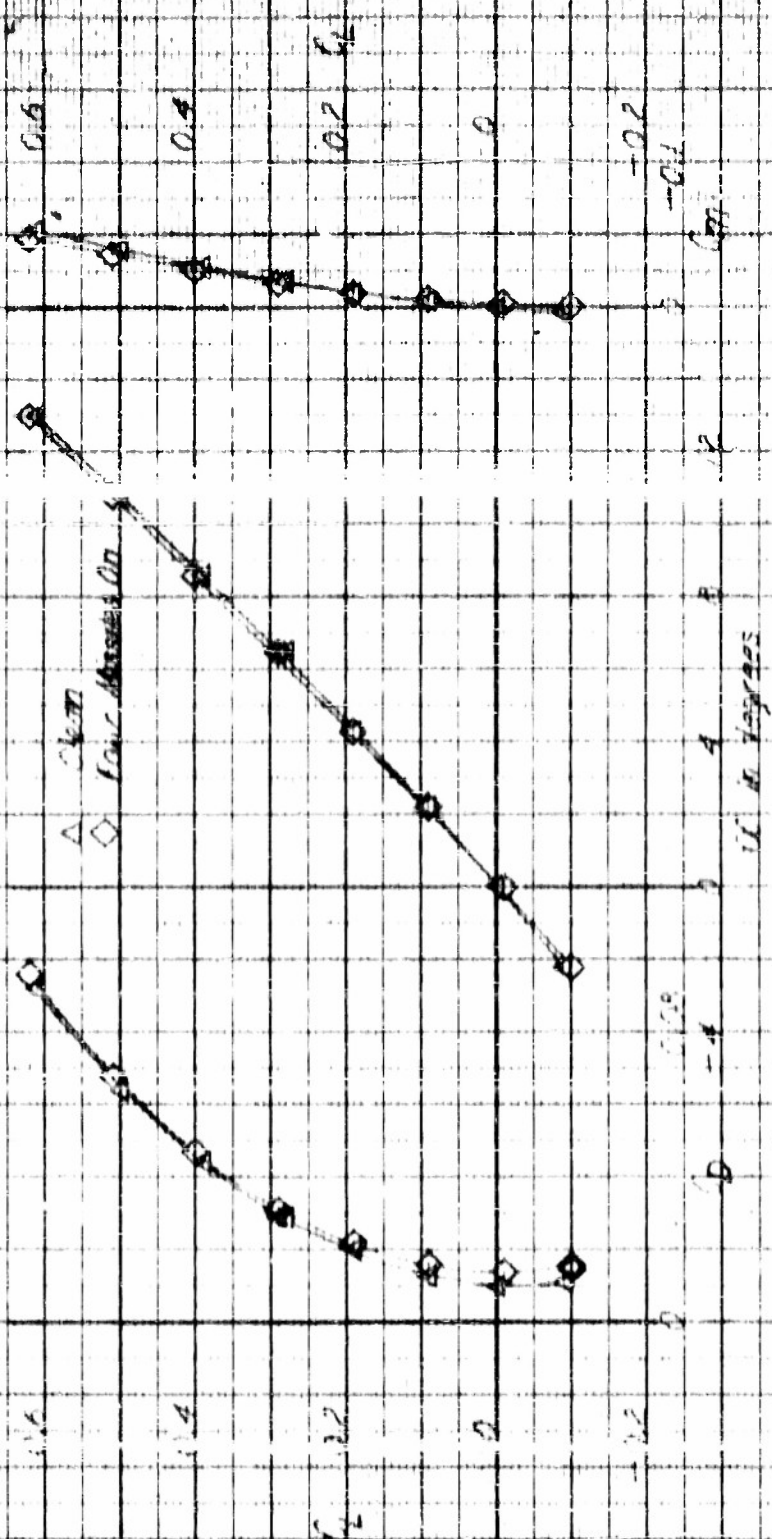


Figure 22 - Comparison of Calculations for C<sub>L</sub> and C<sub>D</sub> - Scale Model

FAD - A Airplane Showing the Effect of FAD on C<sub>L</sub> - Scale Model

X-1 - 1 - 4 Circle Missiles Mounted on the Airplane

on Model Tail, Tail on

18/14/54

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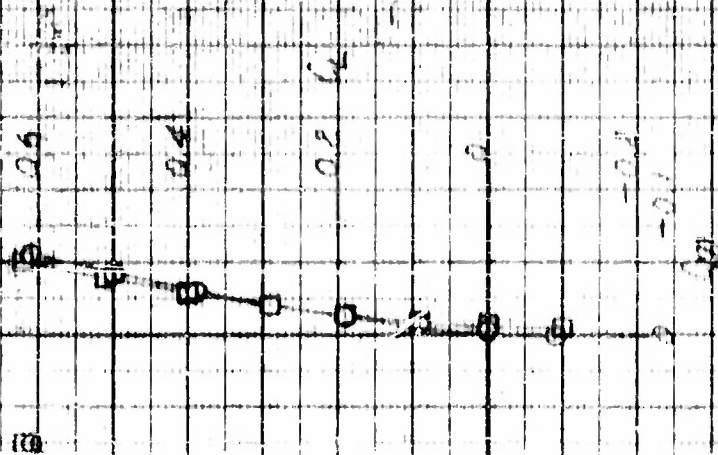
FIGURE 22a



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○ C-130  
□ Four Alouette III

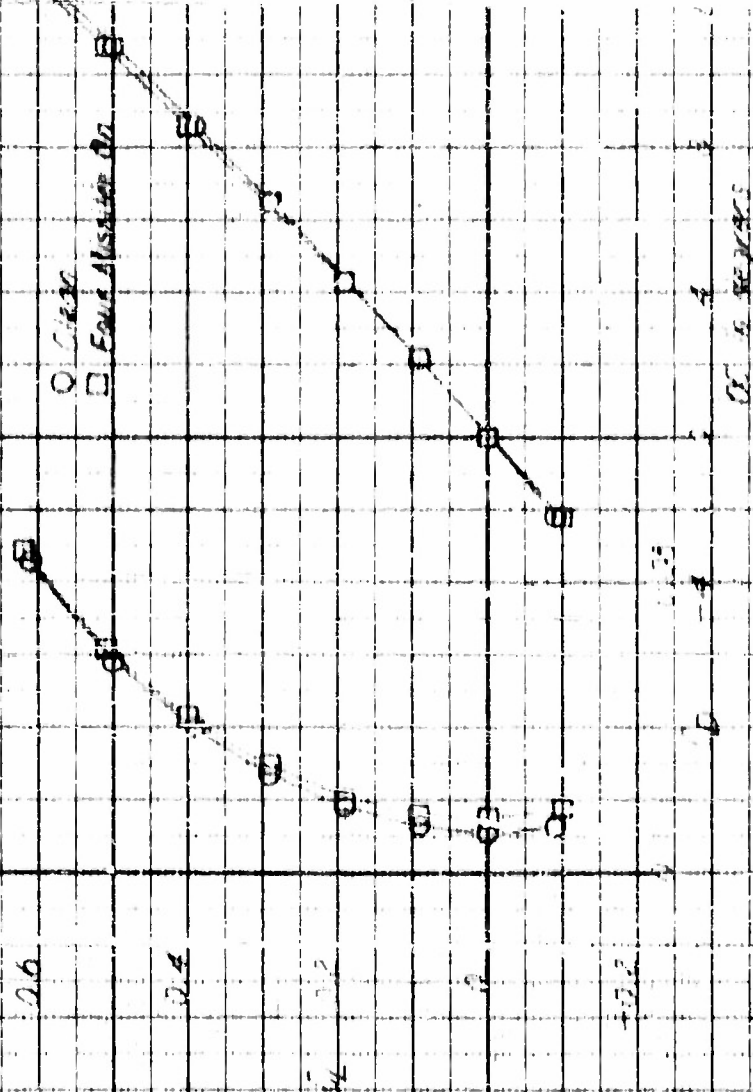


Figure 22 (Continued)

the Model Error, Jan. 1971

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FIGURE 22 b



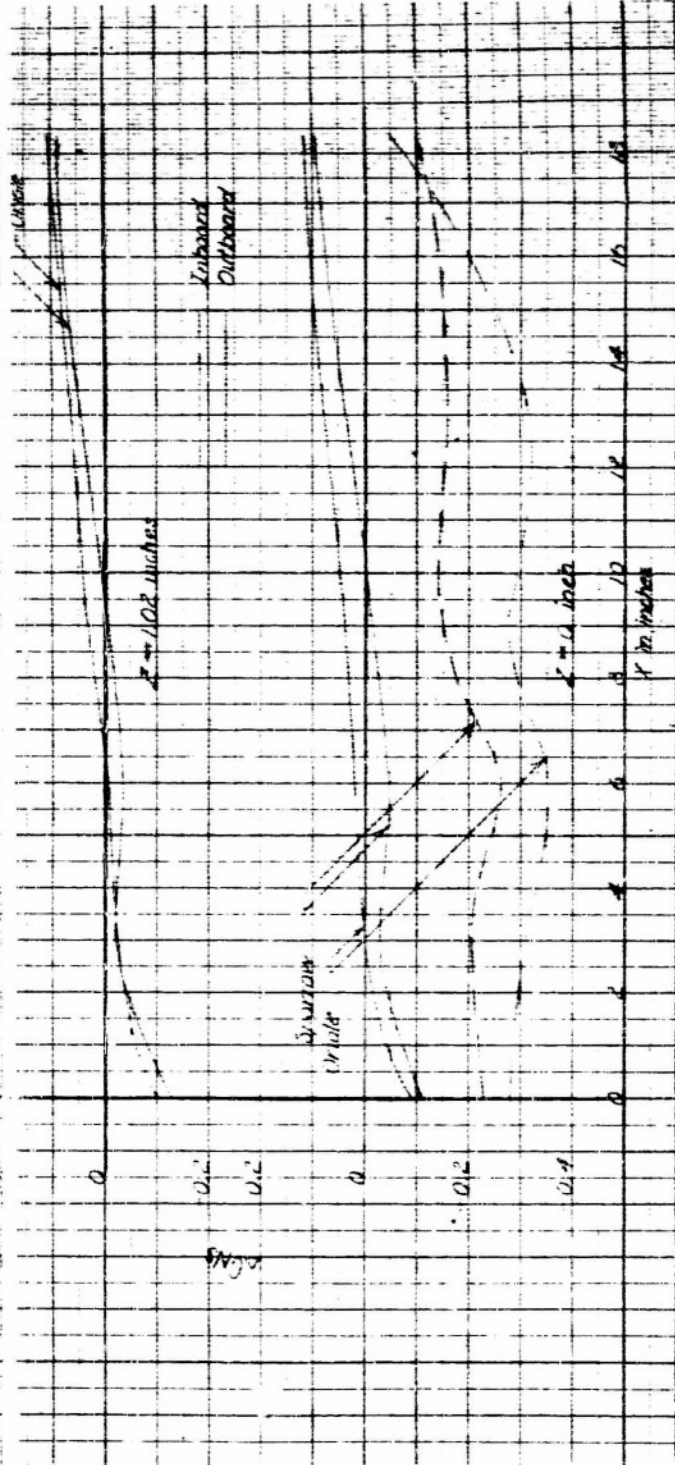
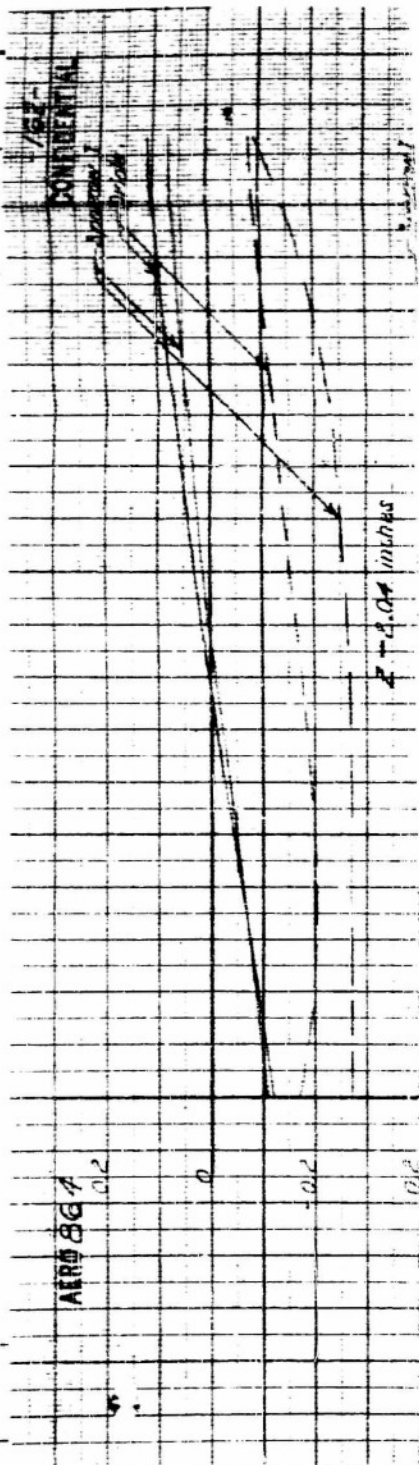


Figure 24 Variation of Airframe Interference on the Normal Force Coefficient of the Drive and Spar row Missiles With Distance

Forward of the Early Position

$$(1) \beta_s = 0; \alpha_s = 0; \alpha_c = 4^\circ$$

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FIGURE 24

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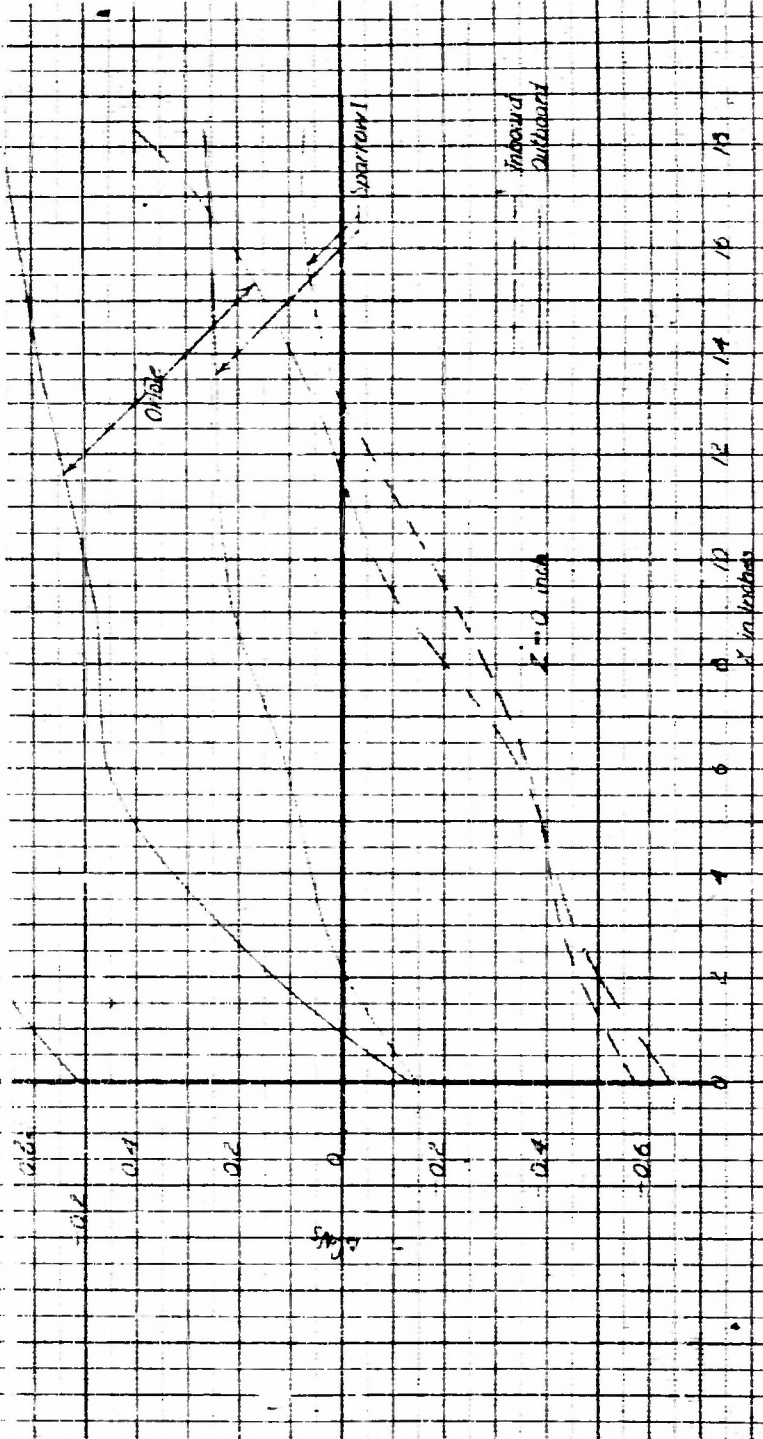
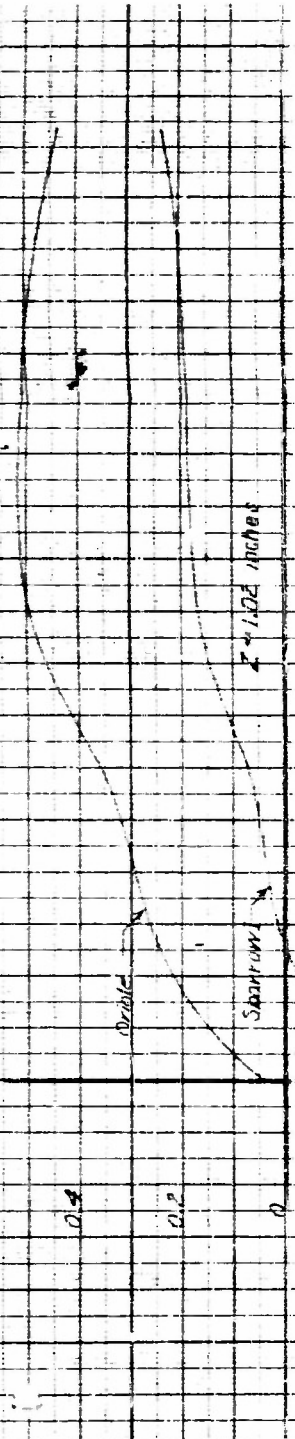


Figure 24 (continued)

(a)  $\alpha_s = 0$ ,  $\alpha_z = 0$ ,  $\alpha = 10^\circ$

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FIGURE 24

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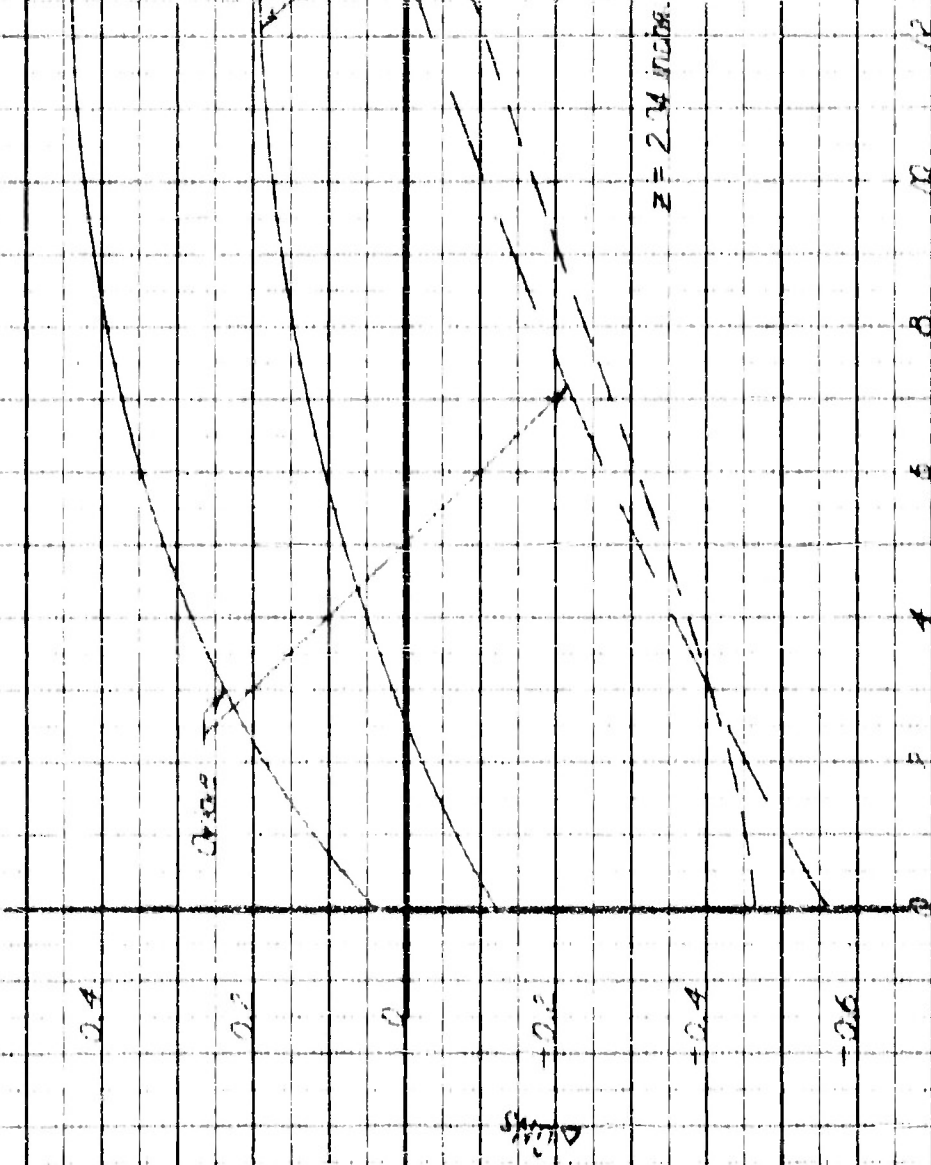
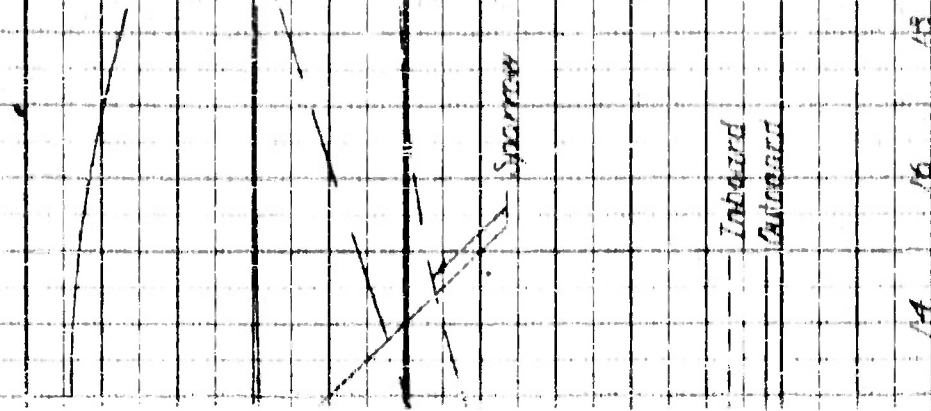


Figure 24 (Continued)

(b) Continued

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FIGURE 24b (Contd)

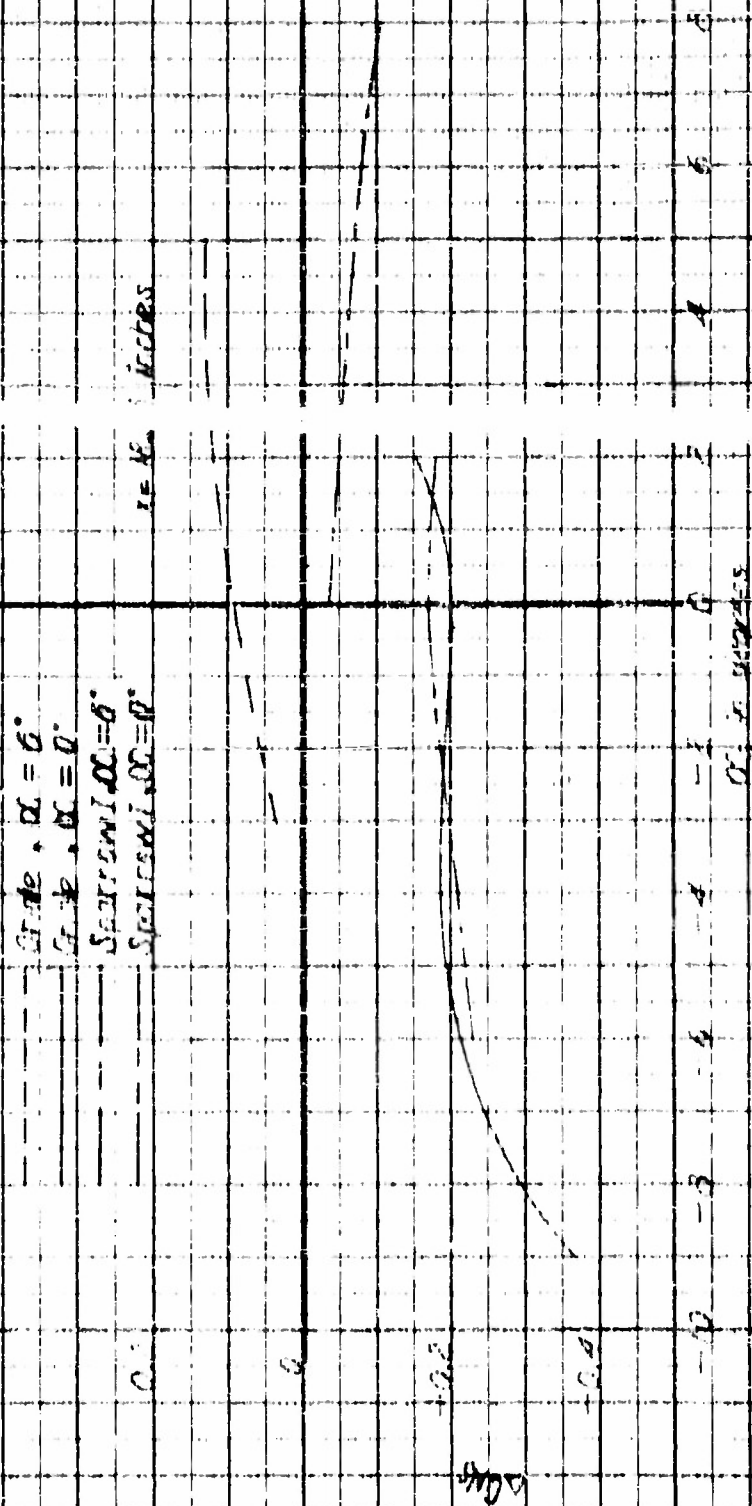


Figure 25 - Variation of Airplane Interference Coefficient of the Tail and Fuselage Members With

The Normal Force Coefficient

at the Angle of Attack



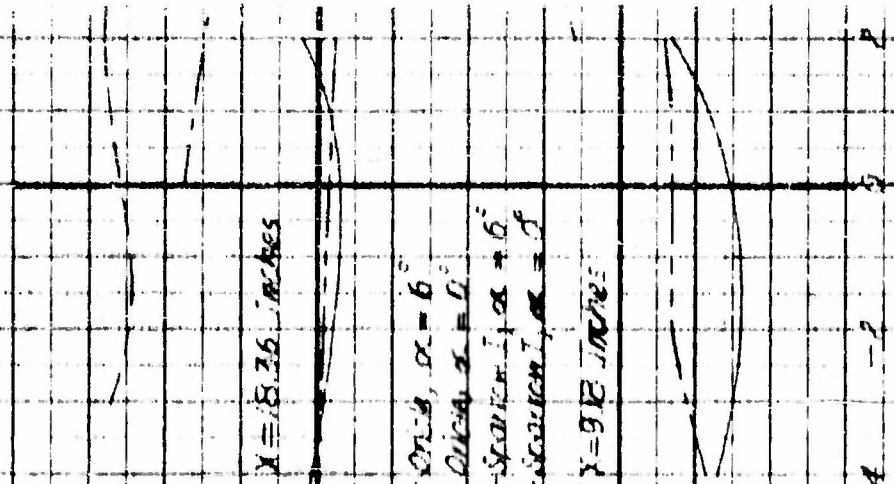
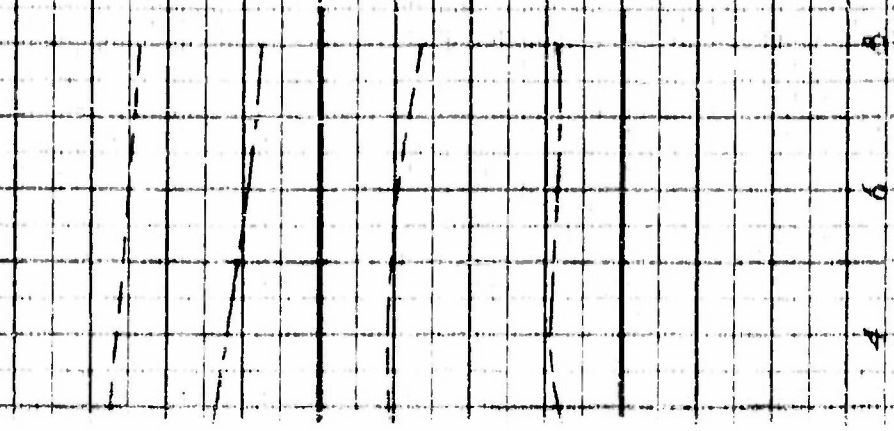


Figure 25 (Continued)

(c) Outboard,  $z = 0$  inch

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$\alpha_0$  is degree

-10 -8 -6 -4 -2 0 2 4 6 8

0.2

0

0.2

0

+0.2

$\lambda = 18.34$  in. sec

$\lambda = 13.26$  in. sec

---  $\alpha = 0^\circ$

---  $\alpha = 0^\circ$

---  $\alpha = 6^\circ$

---  $\alpha = 12^\circ$

(c)  $\alpha = 102^\circ$

PC19 Apr 54

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FIGURE 25c

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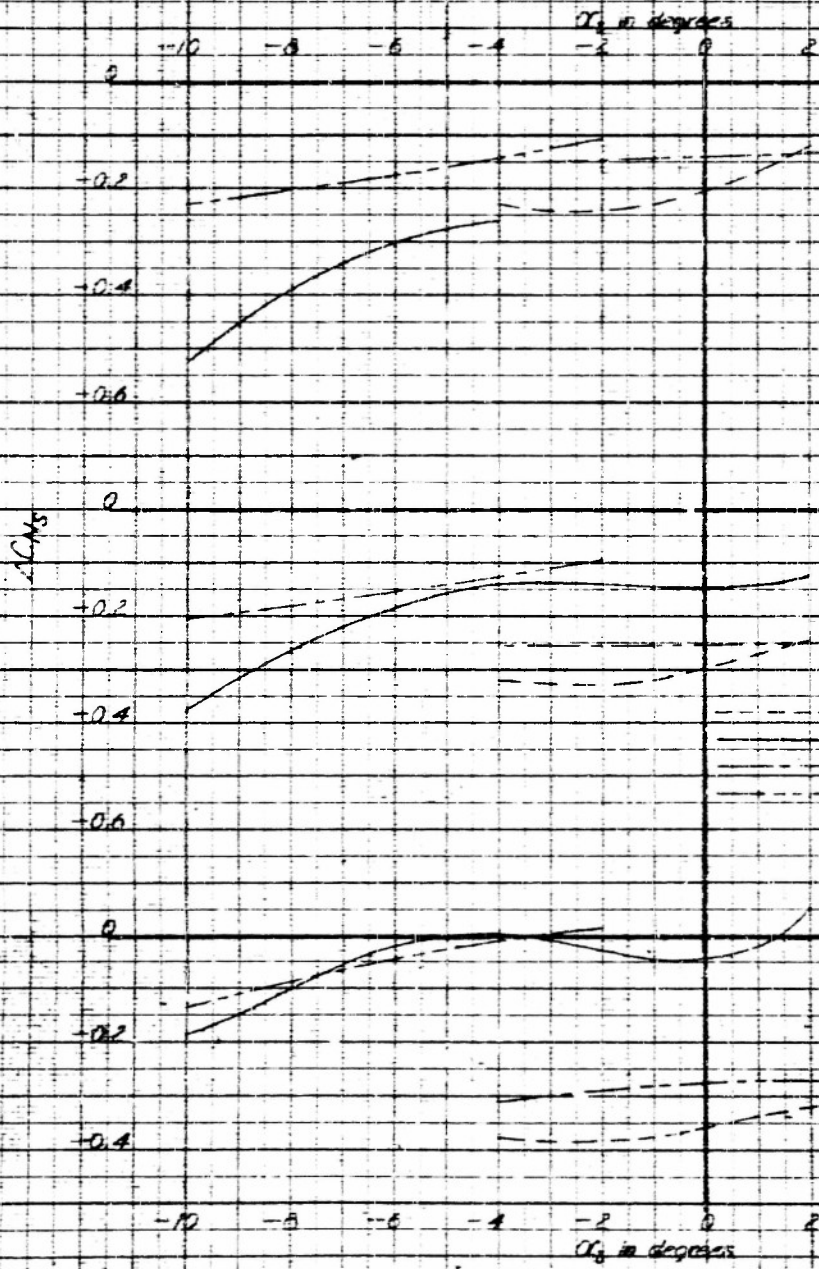


FIGURE 25 D

Figure 25 (Continued)  
(d) Tabored,  $z = 2.04$  inches

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$z = 1.28$  inches

$z = 6.12$  inches

$z = 2.04$  inches

Crack,  $\alpha = 6^\circ$   
Crack,  $\alpha = 0^\circ$   
Sparrow,  $\alpha = 6^\circ$   
Sparrow,  $\alpha = 0^\circ$

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FIGURE 25 c

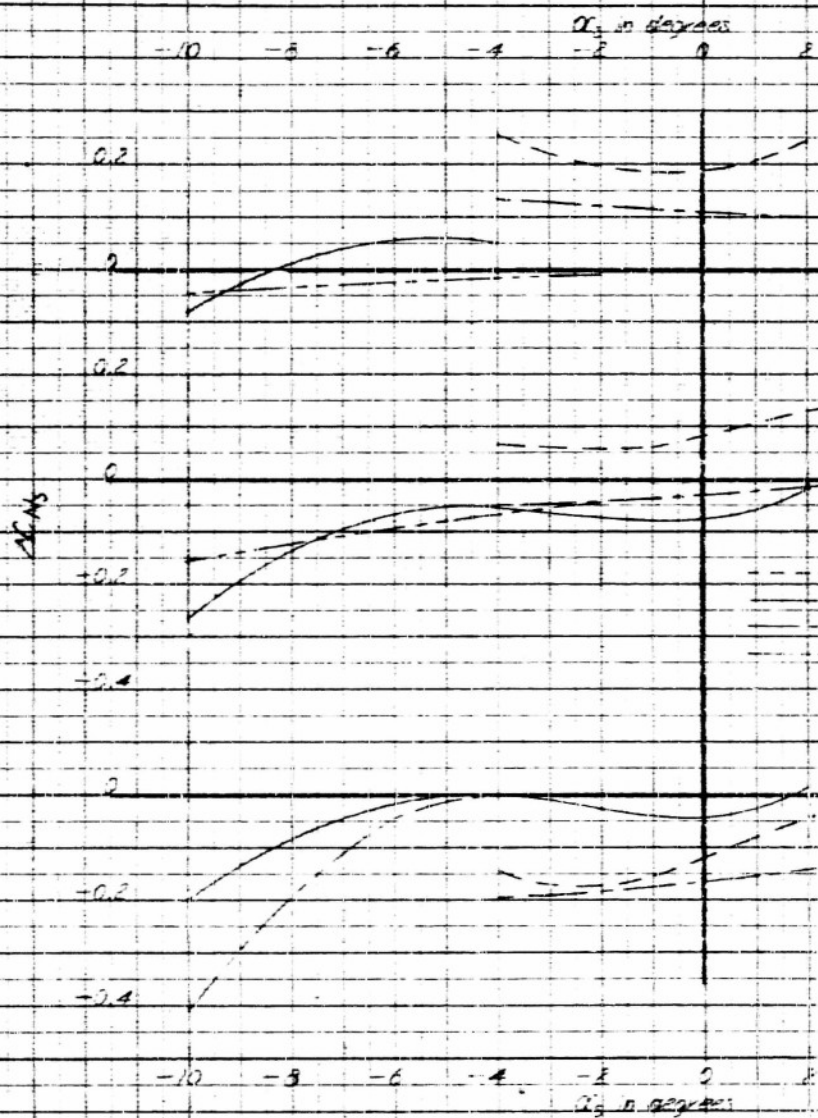


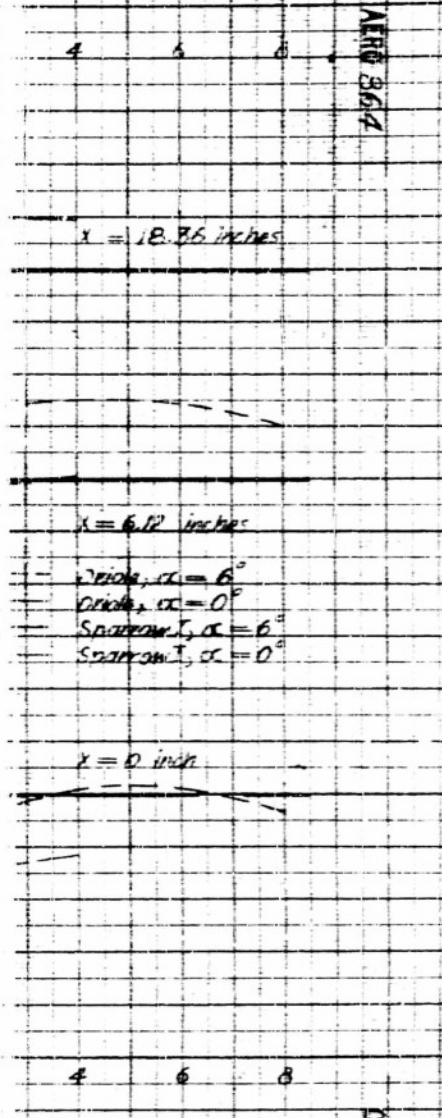
Figure 25 (Continued)

(a) Outboard,  $z = 2.04$

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FIGURE 25 c



$x = 18.35$  inches

$x = 6.12$  inches

Solid,  $\alpha = 6^\circ$   
Dashed,  $\alpha = 0^\circ$   
Squiggle,  $\alpha = 6^\circ$   
Squiggle,  $\alpha = 0^\circ$

$x = 0$  inch

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$\alpha = 0 \text{ m/s}$

4 5 6

0

-0.2

$\Delta C_N$

-0.4

-0.6

---  $\alpha = 0^\circ$

---  $\alpha = 0^\circ$

---  $\alpha = 0^\circ$

---  $\alpha = 0^\circ$

-10 -5 0 5 10

$\alpha_2$  in degrees

Figure 25 (Continued)

Intercept,  $z = 4.03 \text{ inches}$

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FIGURE 25f

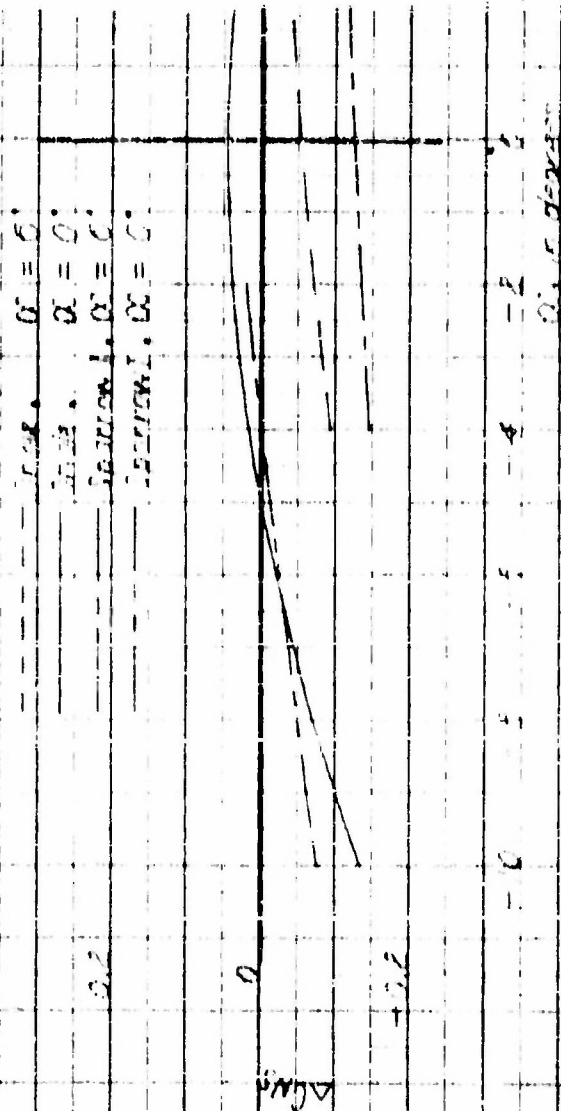


Figure 25 (continued)

Figure 25,  $z = 4.63 \text{ inches}$



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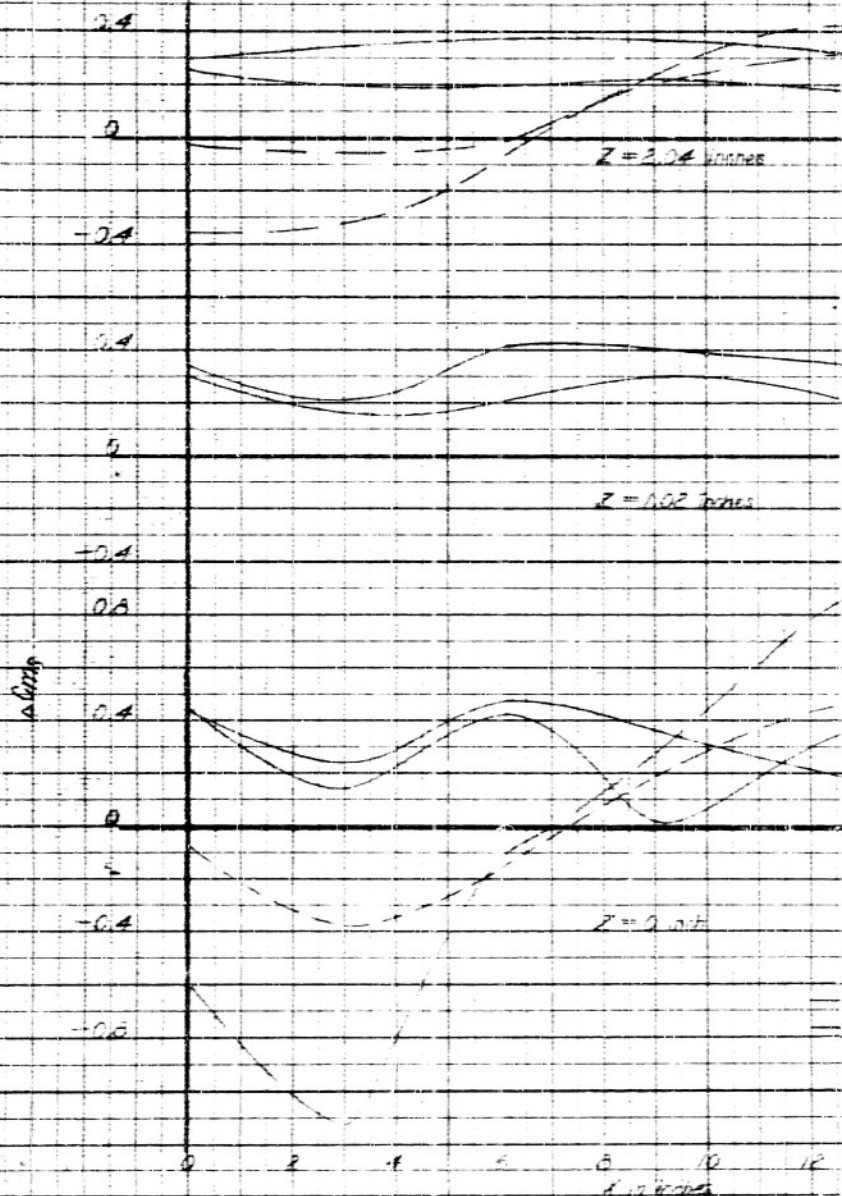
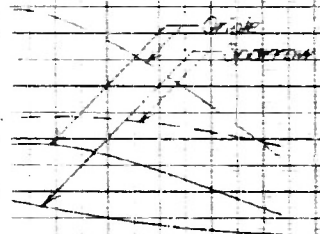
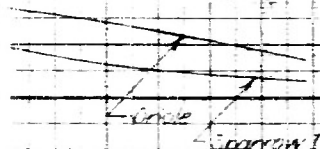
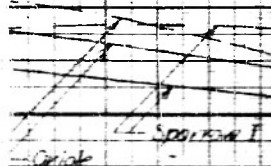


FIGURE 26.0

Figure 26 - Variation of Airplane Interference on the Pitching-Moment Coefficient on the Oriskany and Sparrow I Missiles With Distance Forward of the Carry Position  
 $\alpha_1 = 0^\circ$ ,  $\alpha_2 = 0^\circ$ ,  $\alpha_3 = 4^\circ$

AFRO B64



Inboard Outboard

14 16 18

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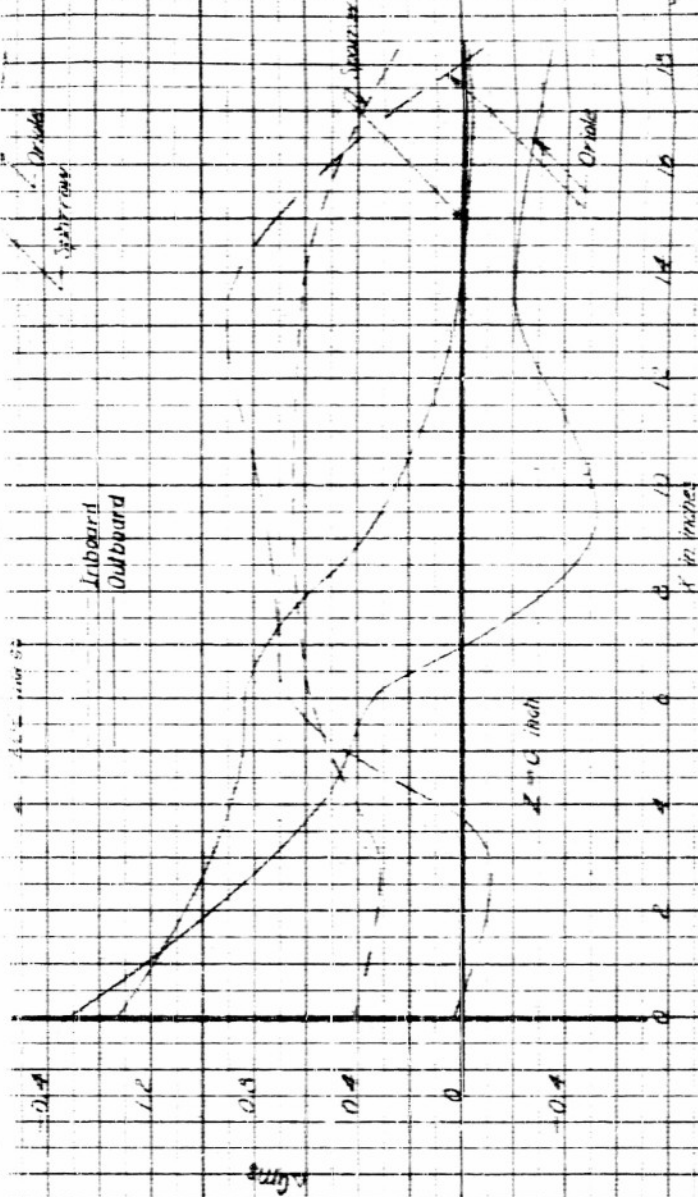
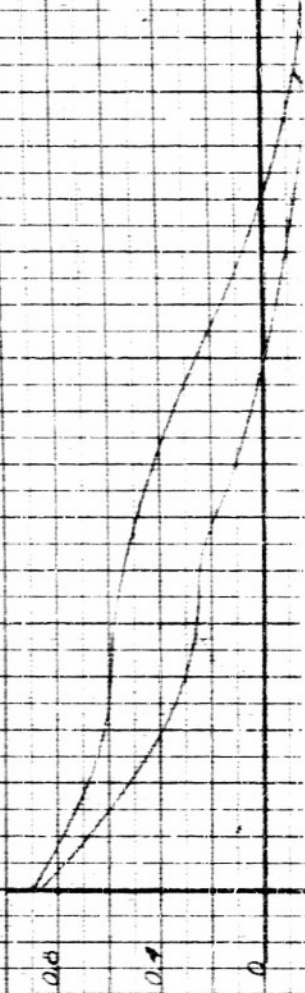


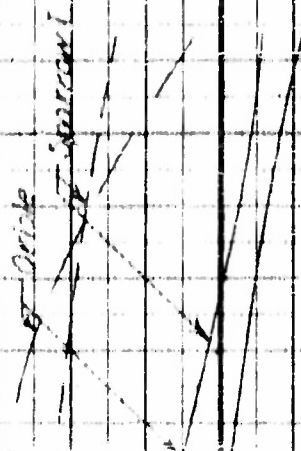
Figure 2b (Continued)

(a)  $\alpha_s = 0^\circ$ ,  $\alpha_{s, \text{max}} = 10^\circ$

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Interpre  
Outboard

$Z = 8.54$  inches

10 inches

Figure 26 (continued)

(b) Concluded

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FIGURE 26b (cont.)



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Deck,  $\alpha = 6^\circ$   
 Cradle,  $\alpha = 0^\circ$   
 Support I,  $\alpha = 6^\circ$   
 Support II,  $\alpha = 0$

15.36 inches

4 6 8

12. Picting--Moment Coefficient

Cosine Angle of Attack

On Inboard 2-0.1.0

Figure 27--Indication of Airplane Interference on

1.74 Cradle over Support I Missiles with

On Inboard 2-0.1.0

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FIGURE 27a

AERO 864

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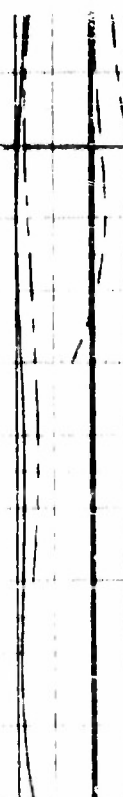
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4 5 6

$x = 9.15$  inches

100



$x = 1.5$   
 $x = 2.0$   
 $x = 3.0$   
 $x = 4.0$



-10 -5 -4 -2 0  
 $\alpha$  in degrees

FIGURE 27 (CONTINUED)

(a) Continuation,  $z = 0$

171744x 54

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FIGURE 27 D

AERO 864

+177-

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$X = 18.36$  inches

$X = 18.26$  inches

$X = 18.26$  inches

4 6 8

0.4

0

0.8

0.4

0

0.8

0.4

0

-10

-5

0

5

10

$\Delta C_L$  in degrees

FIGURE 27 CONTINUED

(c) OUTBOARD  $X = 18.26$  inches

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FIGURE 27 C



12/9/62 34

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FIGURE 27A

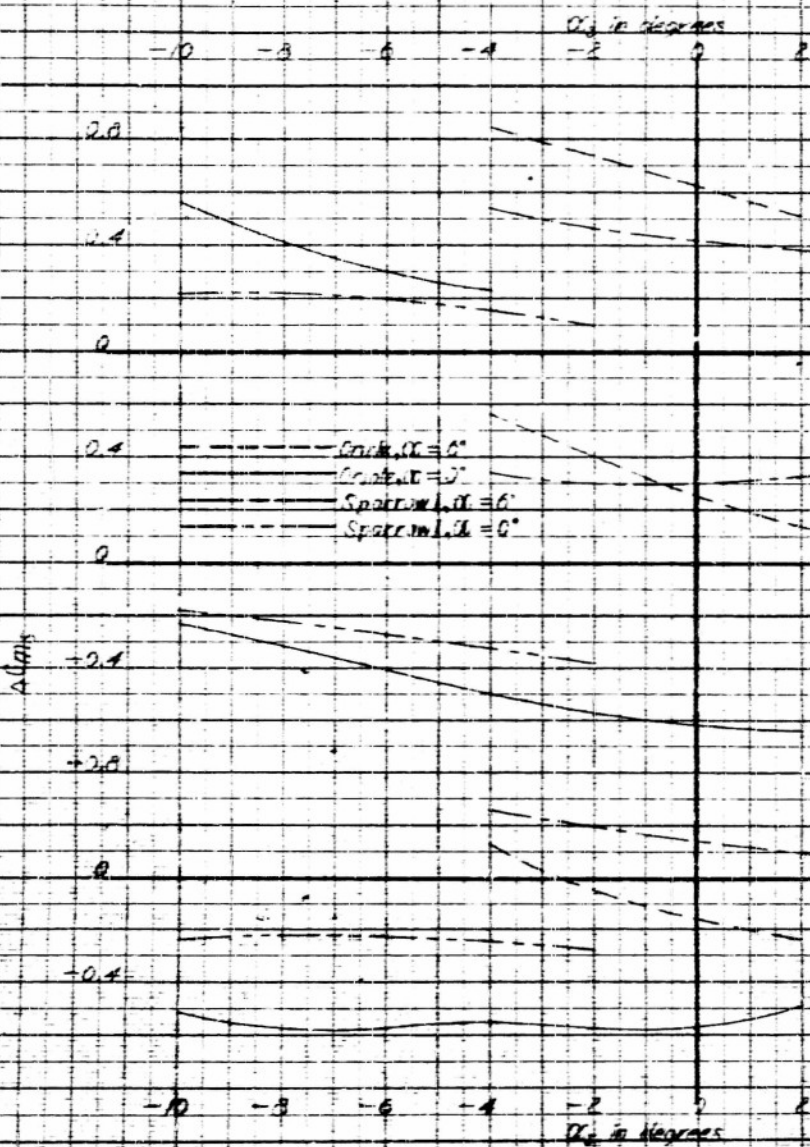
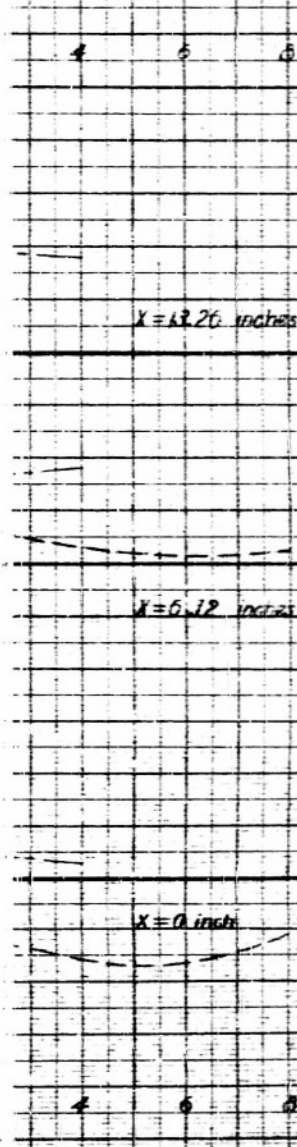


FIGURE 27 (Continued)

Aluminum,  $\bar{z} = 2.04$

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172244-44

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FIGURE 27.2

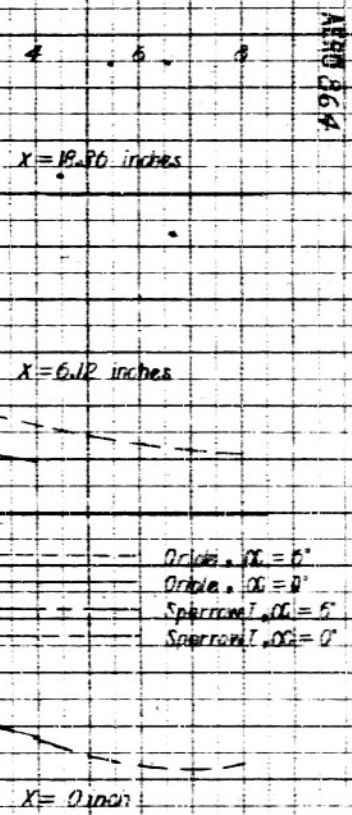
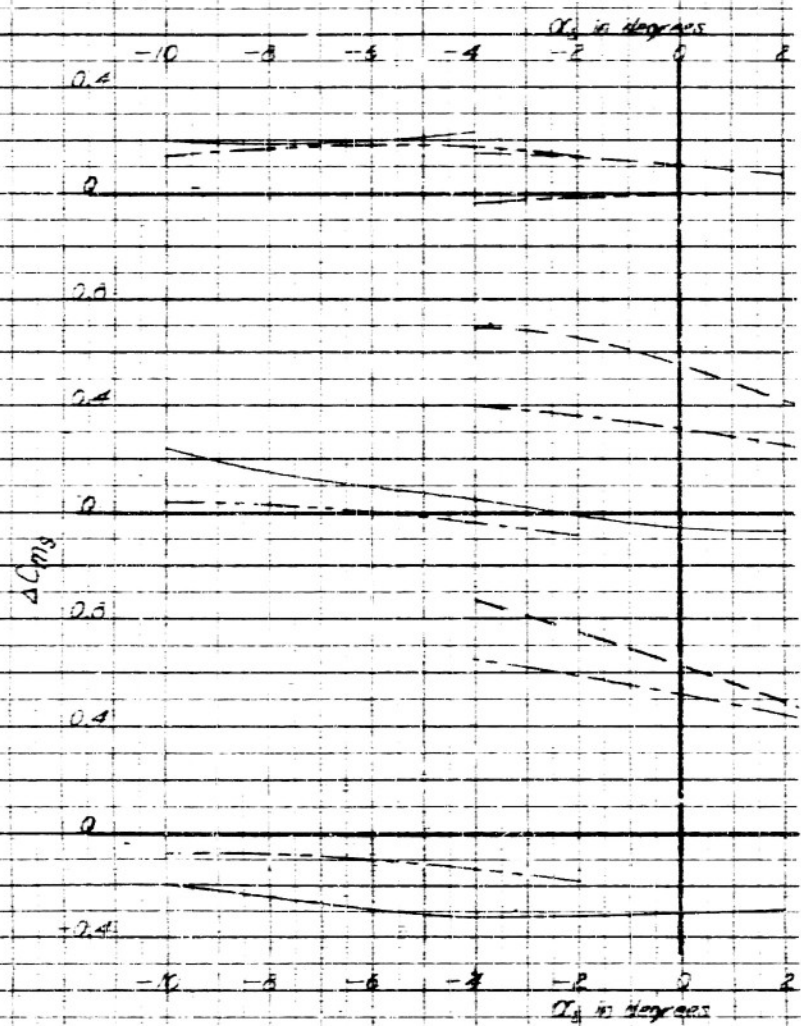


Figure 27 (continued)

(e) Outboard,  $z = 204$  inches

172244-44

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FIGURE 27.2

AERO 884

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$\alpha = 0^\circ$   
 $\alpha = 0^\circ$   
 $\alpha = 0^\circ$   
 $\alpha = 0^\circ$

$\alpha = 0^\circ$

$\alpha$  in degrees

Figure 27 (Continued)

$\alpha = 0^\circ$ ,  $\beta = 4.08$  inch

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FIGURE 27P



MEMO 364

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Ordnance,  $\alpha = 6^\circ$   
 Ordnance,  $\alpha = 0^\circ$   
 Ordnance,  $\alpha = 6^\circ$   
 Ordnance,  $\alpha = 0^\circ$

= 2 inch

4 6 8

2

5

-2

-4

-6

-8

-10

-12

-14

-16

$\alpha_g$  in degrees

Figure 27 (continued)

(g) Ordnance,  $\alpha = 4.08$  inches

2.4

2

-0.4

2 inch

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FIGURE 27g

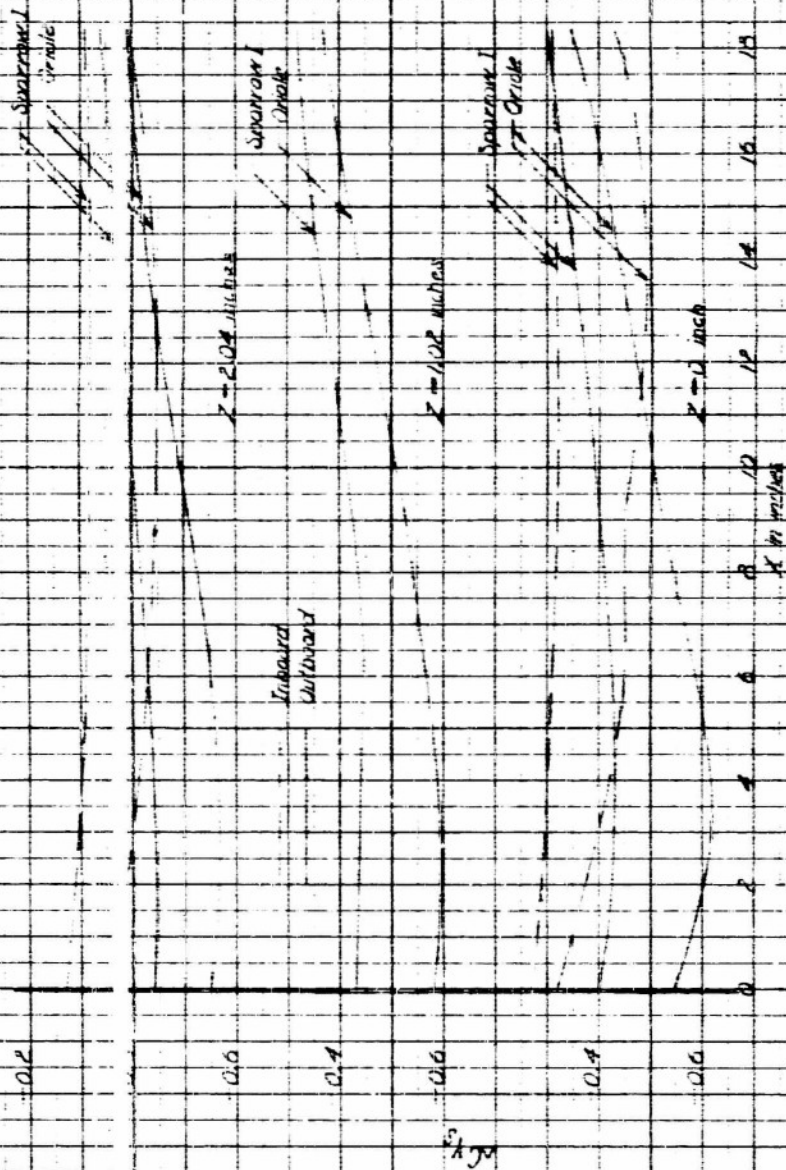


Figure 28-Variation of Airplane Interference on the Lateral Force Coefficient of the Oriole and Sparrow Missiles With Distance Forward of the Carry Position

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-0.6  
-0.5  
-1.0  
-1.2

unavailable

Ortate

1/2 inch

-1.4

-1.0

-0.8

-1.0

-1.2

-1.4

-1.6

2

4

6

8

10

12

14

16

18

20

22

24

Figure 28 (Continued)

(b)  $\theta_3 = 0^\circ$ ,  $\alpha_3 = \alpha$ ,  $\alpha_c = 10^\circ$

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PROG 1754

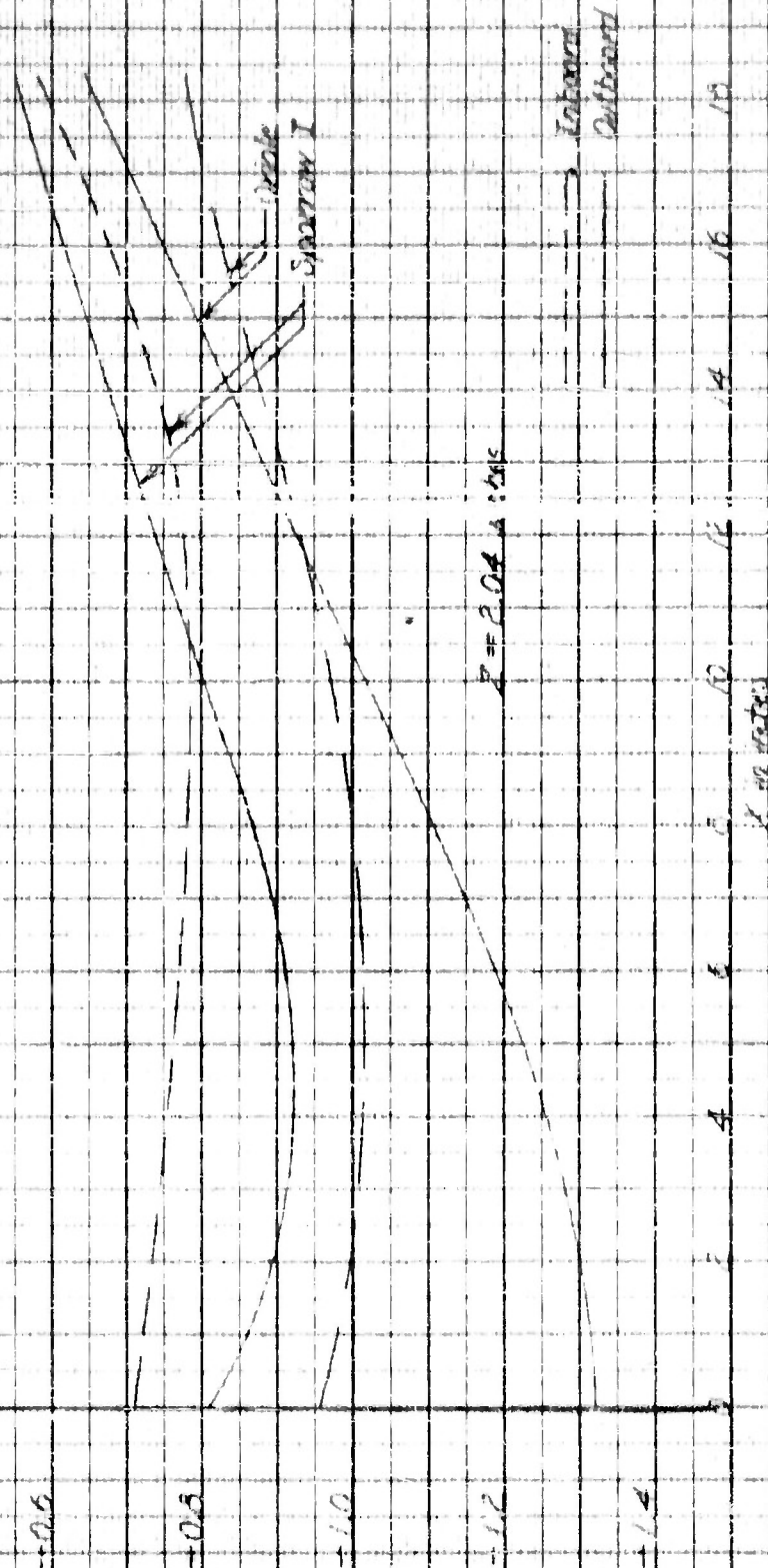
FIGURE 28b



NERO 864

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$\alpha = 0^\circ$   
 $\alpha = 0^\circ$   
 $\alpha = 0^\circ$   
 $\alpha = 0^\circ$

$x = 18.75$  inches

0

-0.2

+0.4

-0.6

-1.0

-1.5

-2.0

-2.5

-3.0

-3.5

-4.0

-4.5

-5.0

-5.5

-6.0

CC in inches

Figure 29 - Variation of Airplane Interference in 24' Altitude - From Chaffin

of the Circle of 1.5' Altitude Interference with the Angle of Attack

CC Interference  $\alpha = 0^\circ$  Interference

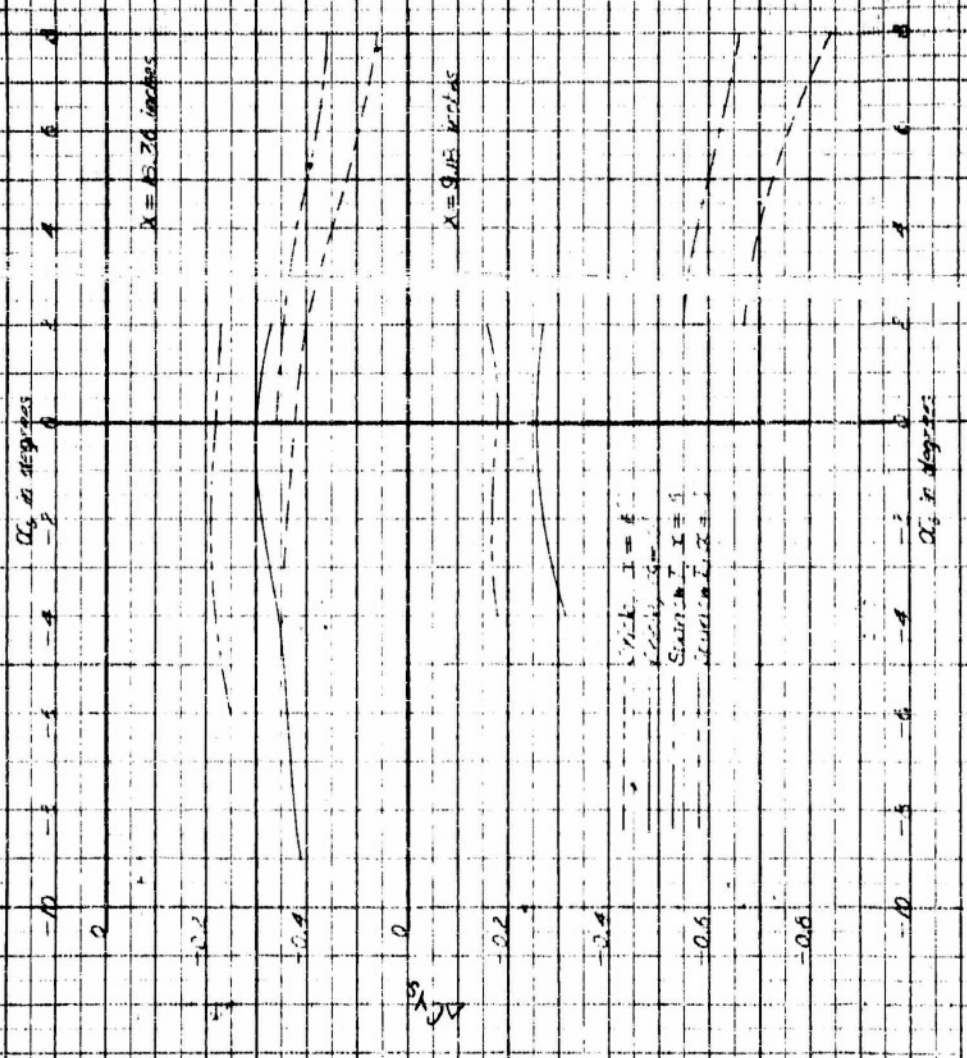
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FIGURE 29a

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Fig. 16. 29 (Continued)

FIGURE 29 Δ



ASPD 26-4

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ASPD 26-4

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FIGURE 29

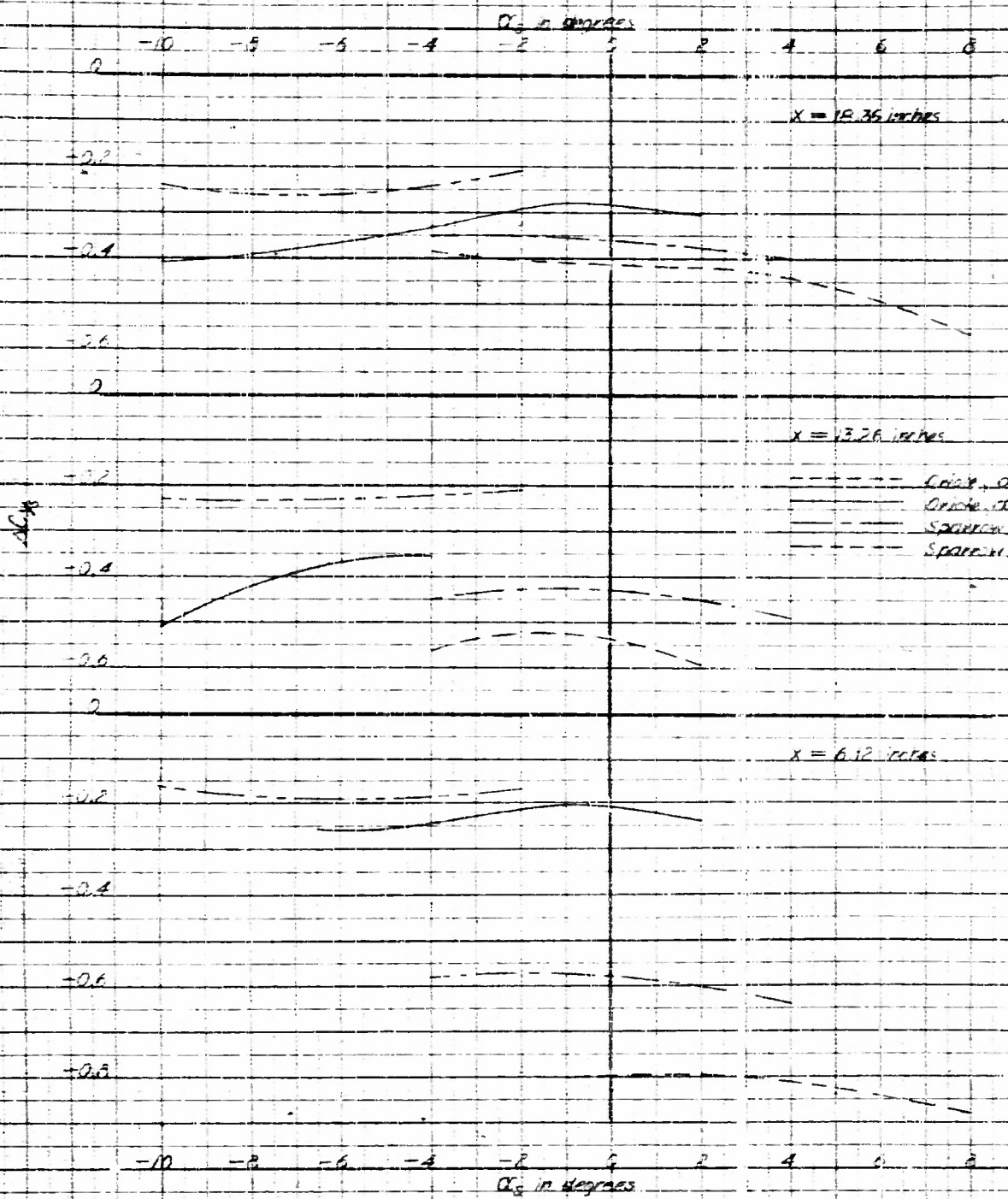


Figure 29 (Continued)  
(c) Outboard,  $z = 1.02$  Inch

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AERO 2304

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$\Delta C_{L\alpha}$

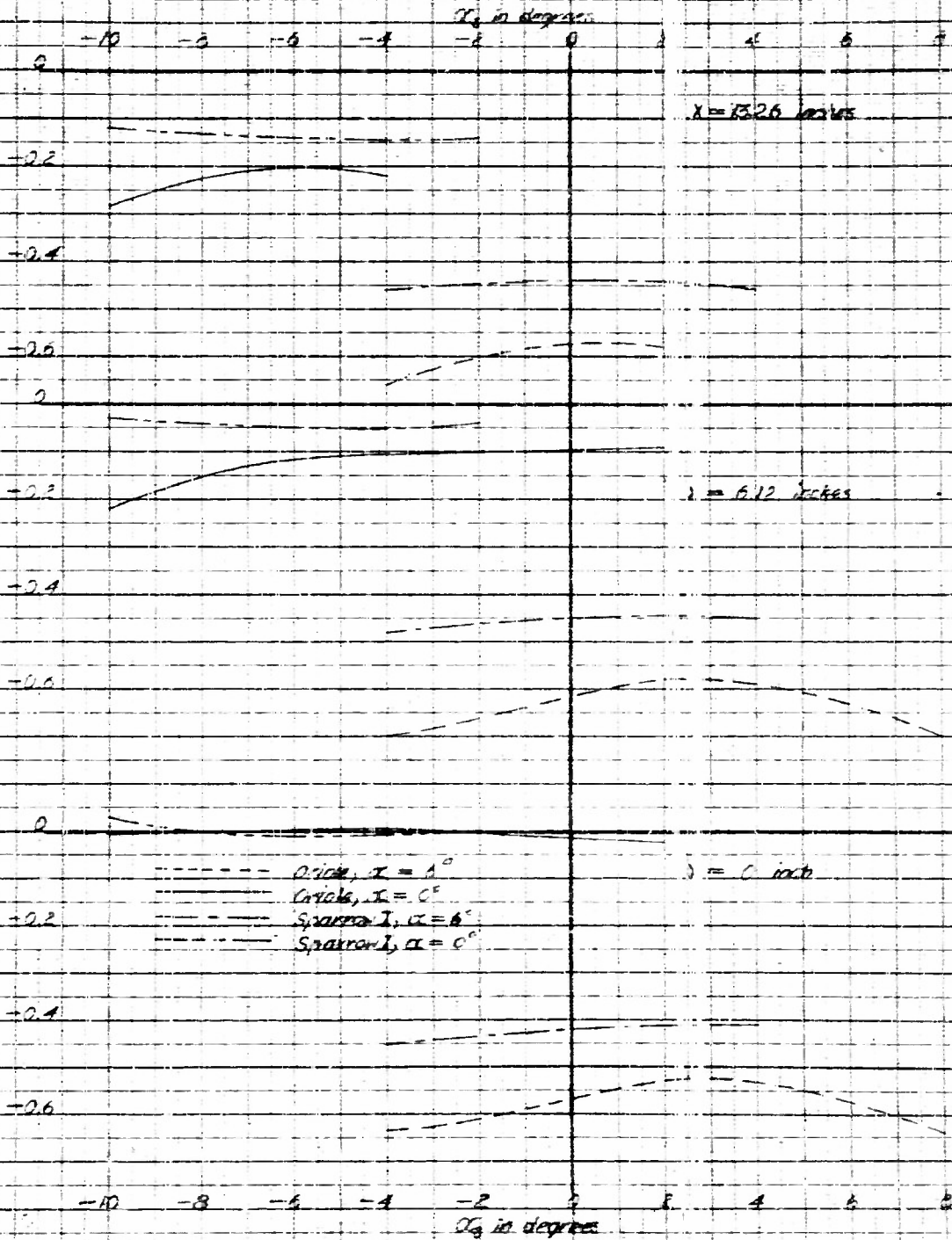


FIGURE 29 D

FIGURE 29 (Continued)  
(b) Tailward,  $x = 2.04$  inches

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AERO

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---  $Or_{10}, \alpha = 6^\circ$   
---  $Or_{10}, \alpha = 0^\circ$   
---  $Sp_{10}, \alpha = 6^\circ$   
---  $Sp_{10}, \alpha = 0^\circ$

$X = 0.1$  inch

-12 -9 -6 -4 -2 0 2 4 6 8

$\alpha$  in degrees

Figure 29 Continued

(E) Inboard,  $Z = 4.08$  inches

12140134

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FIGURE 29

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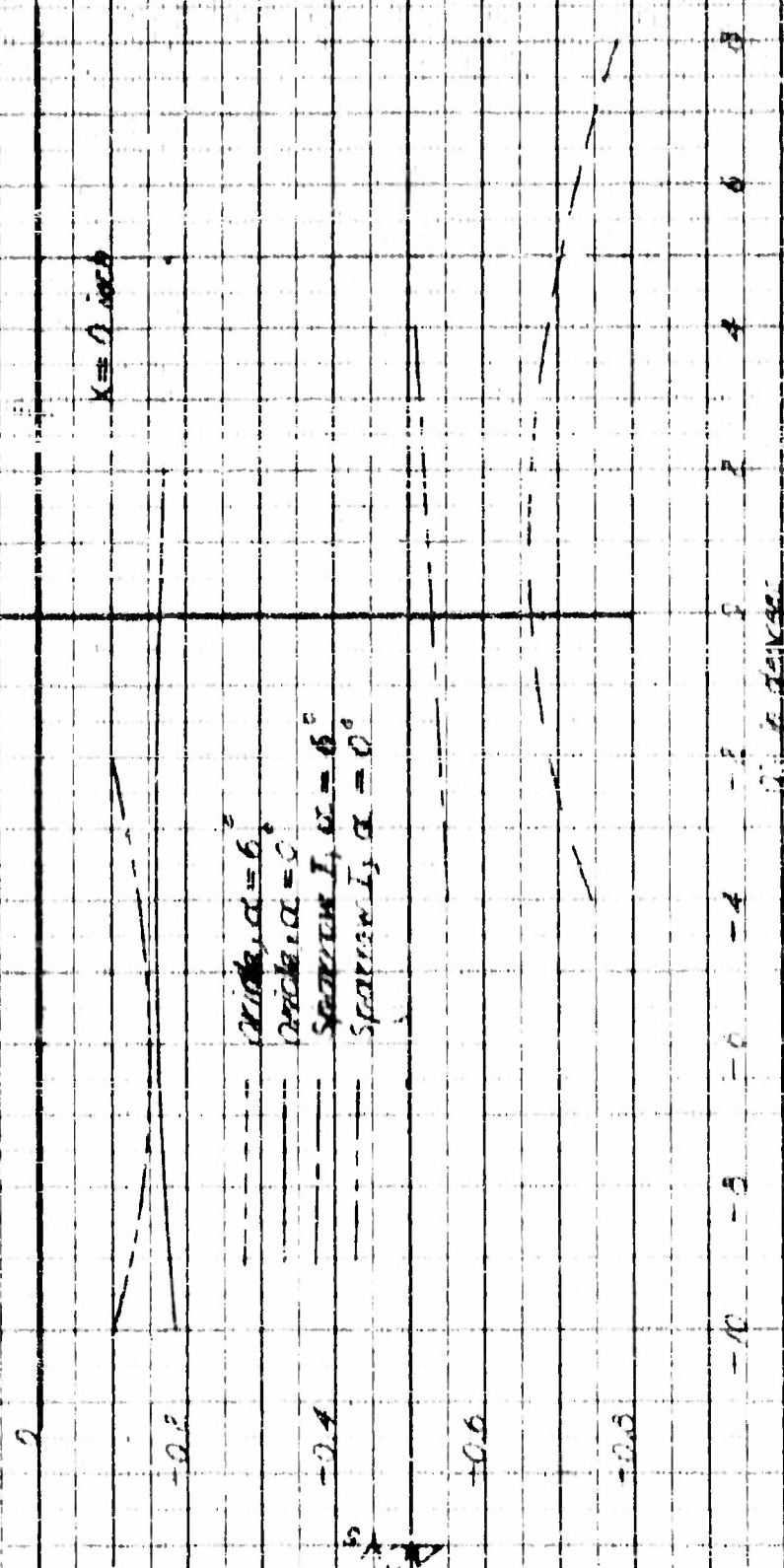


Figure 29 (continued)

(a) outward,  $z = 4.28 \text{ inches}$

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FIGURE 29 g

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AG 6144 04

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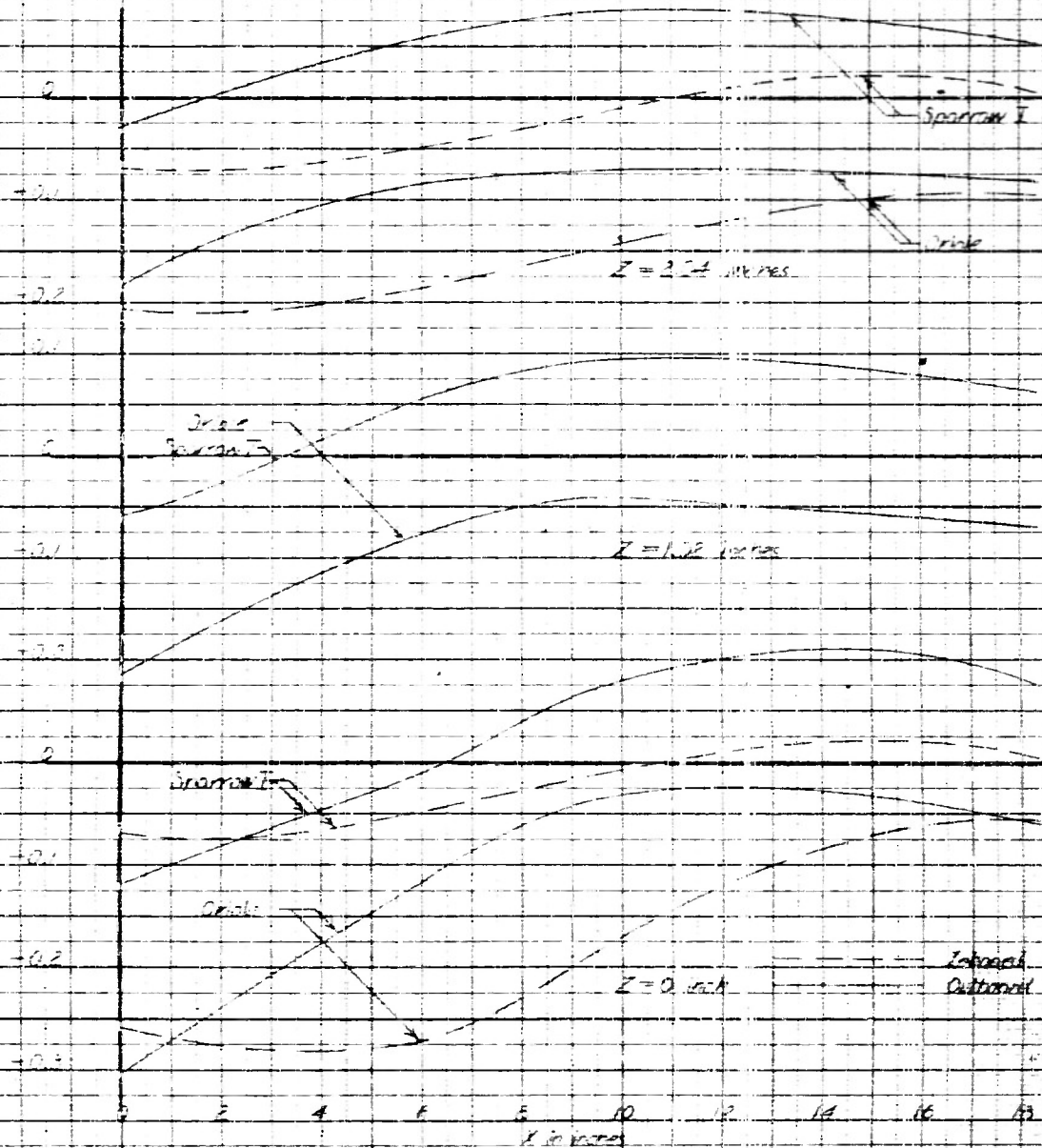


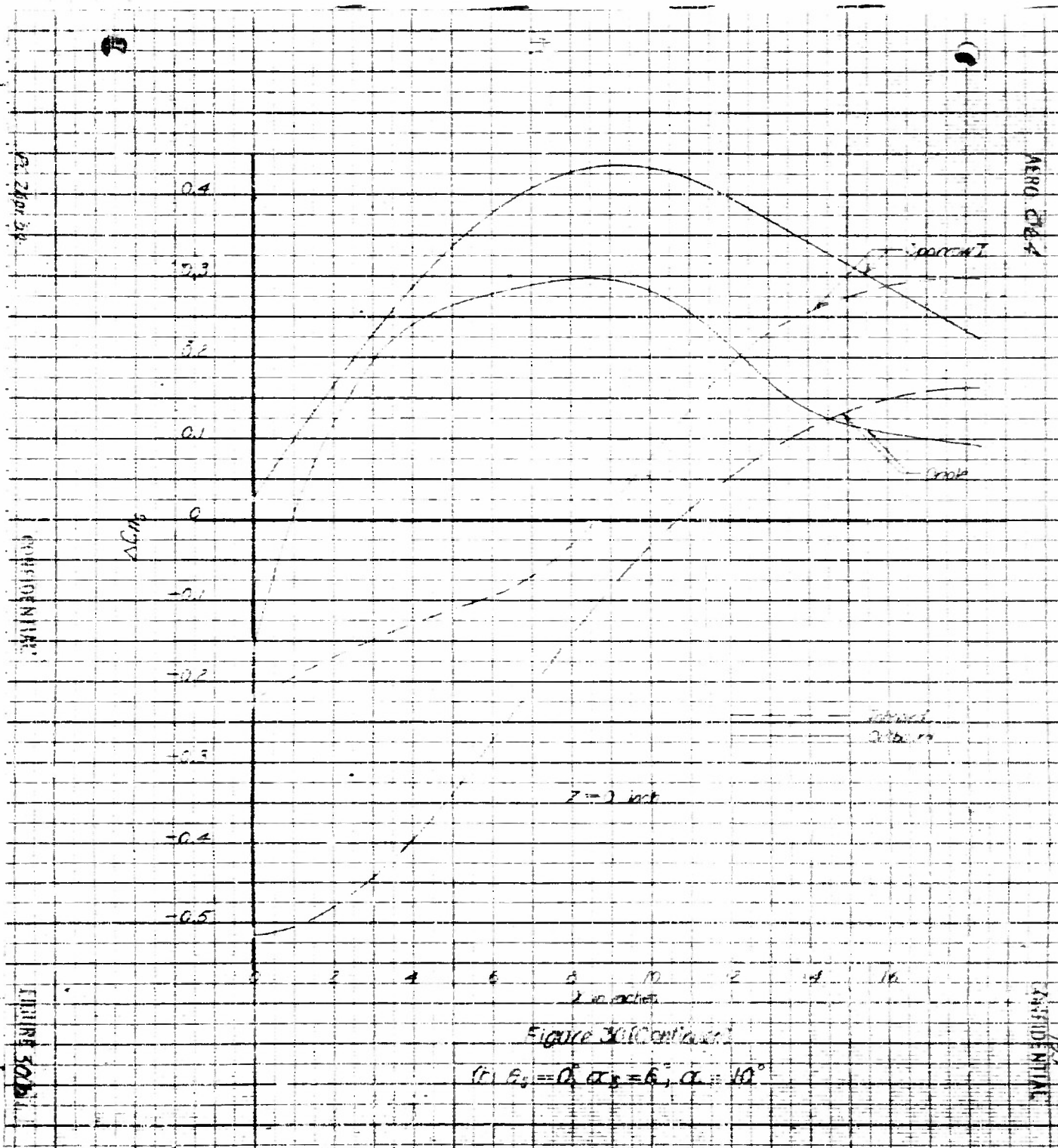
Figure 30-Variation of Airplane Interference on the Varying Moment Coefficients of the Oriole and Sparrow I missile with Distance Forward of the Garry Position

(a)  $\theta_s = 0^\circ$ ,  $\alpha_s = 0^\circ$ ,  $\alpha = 4^\circ$

FIGURE 30.10

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FIGURE 30(a) and (b)

$\Delta C_{ps}$

0.3

0.2

0.1

0

-0.1

-0.2

-0.3

-0.4

-0.5

-0.6

-0.7

-0.8

-0.9

-1.0

2

4

6

8

10

12

14

16

18

$x$  in inches

$Z = 2.04$  inches

$Z = 1.02$  inches

Inboard

Outboard

Inboard

Outboard

Figure 30 (continued)

(b) Concluded

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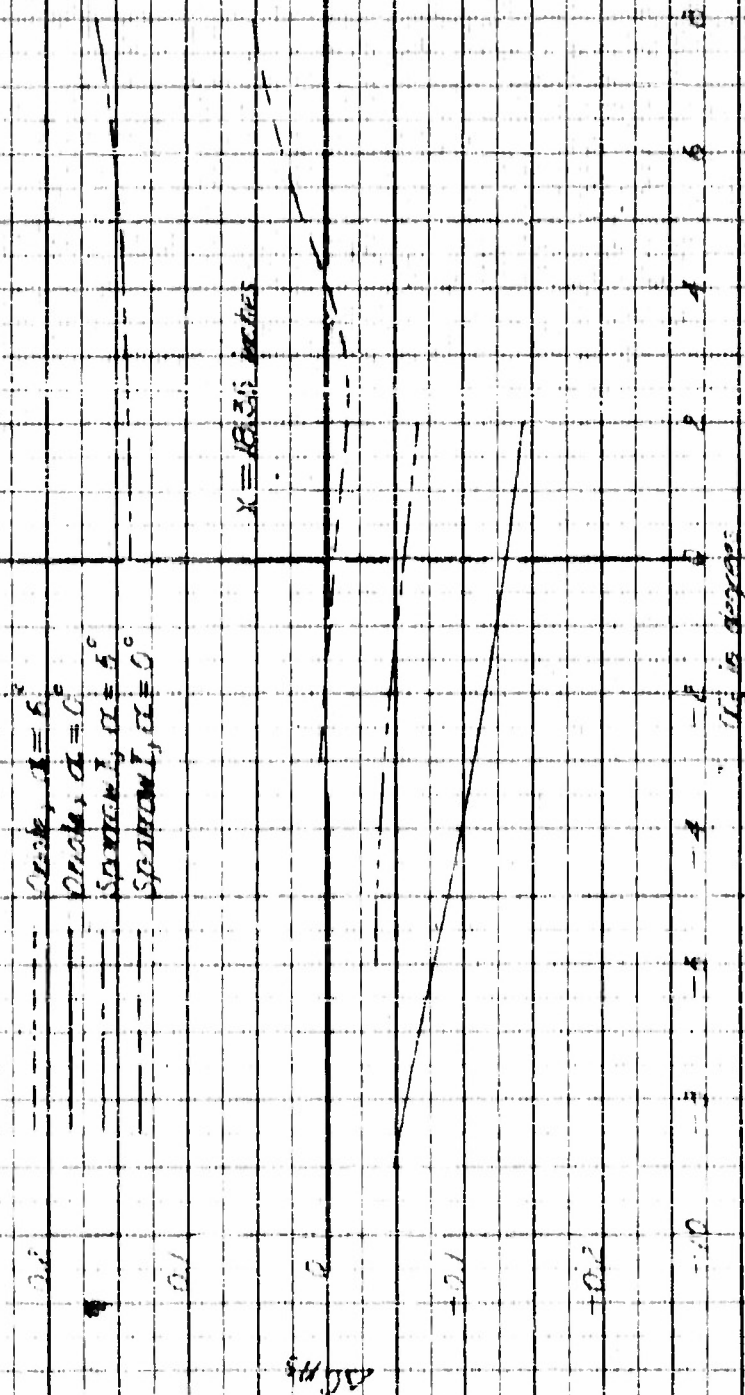


Figure 31-Variation of Aircraft Interference for the Orange-Manned Configuration

X-15 Orange and Sparrow I Missiles with Missile Angle of Attack

for Inboard,  $Z = 0$  inch

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FIGURE 31.0



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Slope

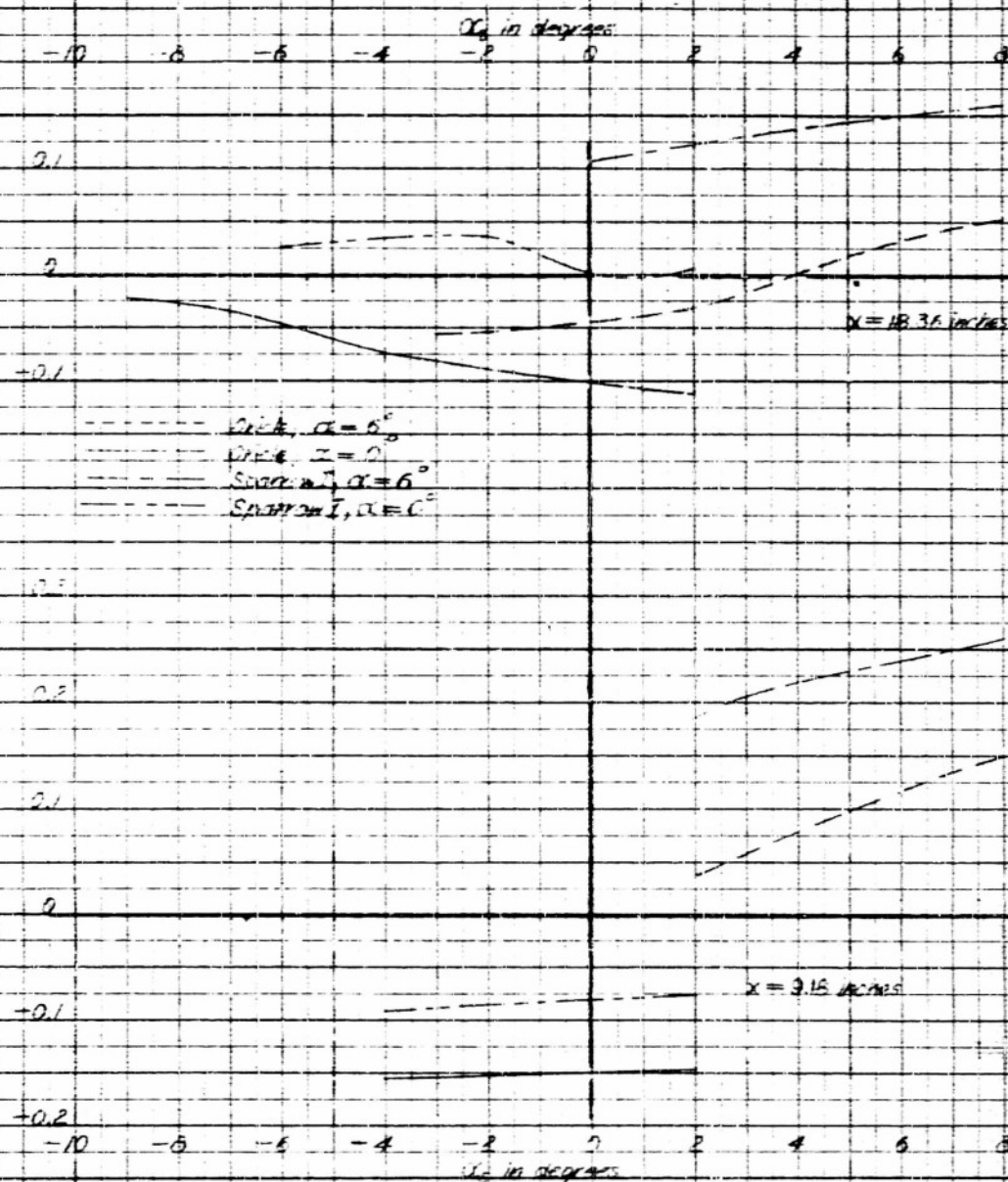
 $x = 3.15$  inches

Figure 31 (Continued)

(b) Continued,  $z = 0$  inch

FIGURE 31

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$\Delta C_{LH}$

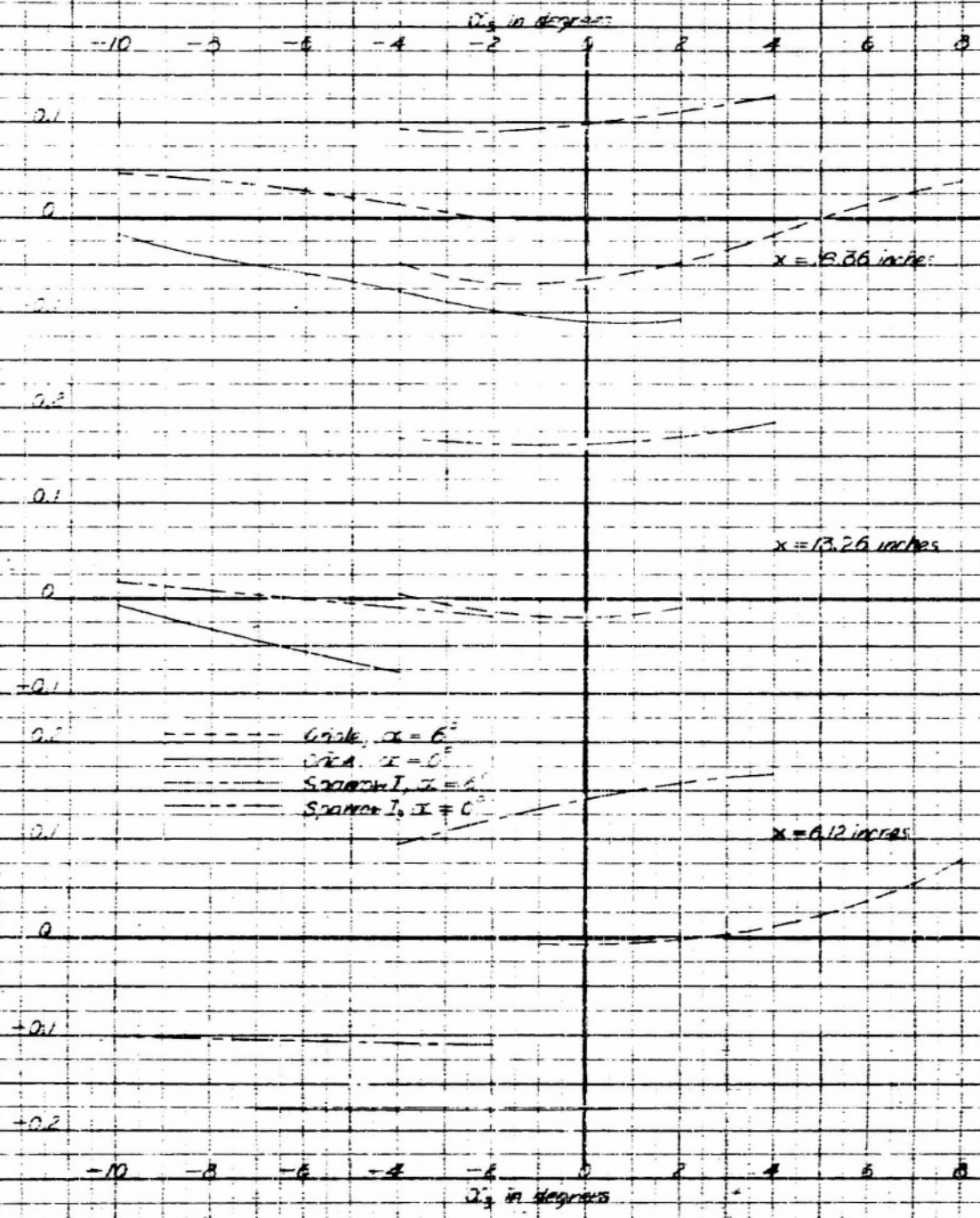


Figure 31 (Continued)

(c) Continued;  $z = 1.02$  inches

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FIGURE 31

FIGURE 31

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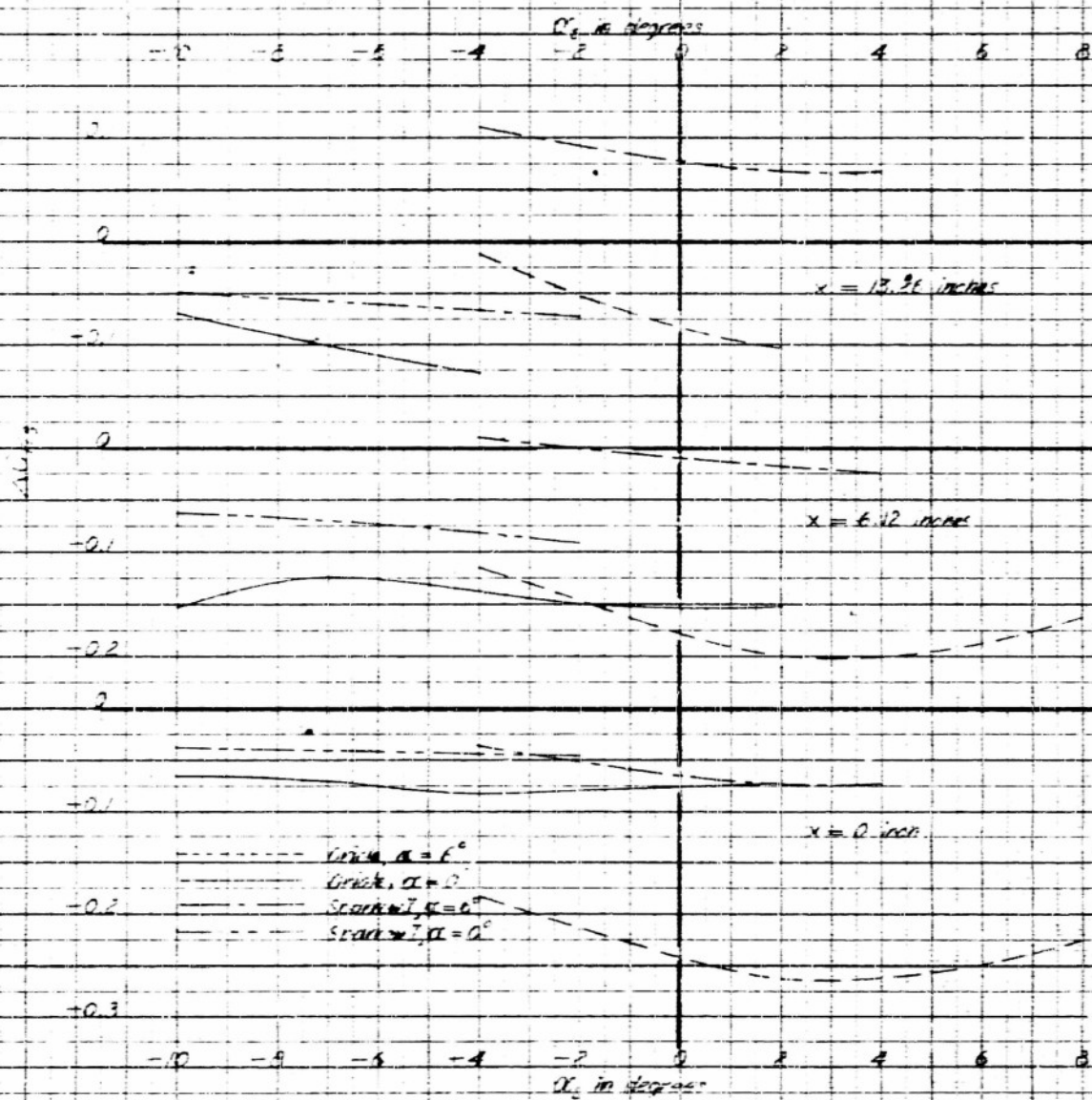


Figure 31 (Continued)

(d) Ingers,  $z = 2.04$  inches

FIGURE 31

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FIGURE 3/e

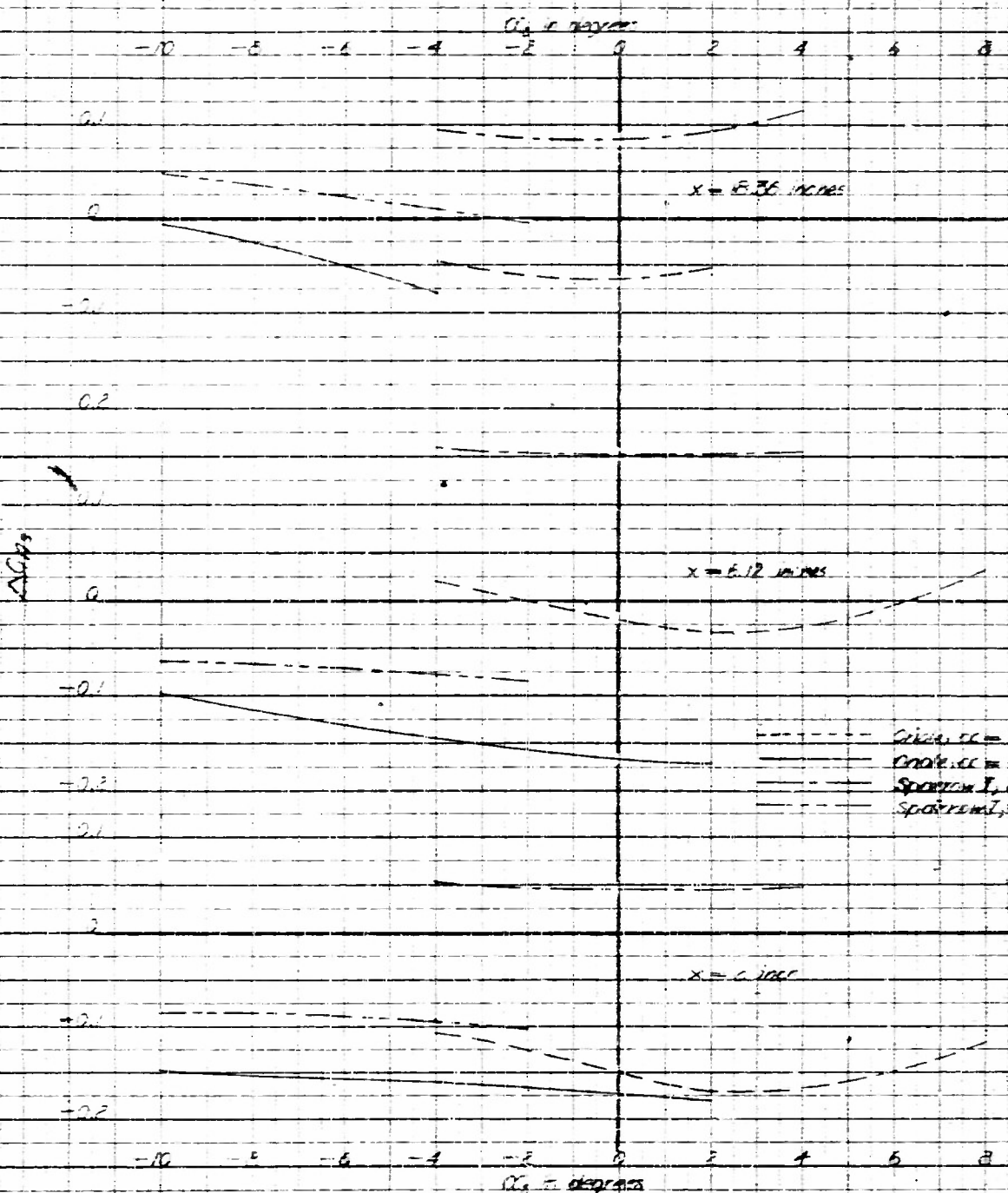


Figure 3/ (Continued)  
(e) Outboard,  $z = 2.04$  inches

--- Circle,  $\alpha = 6^\circ$   
 --- Wick,  $\alpha = 5^\circ$   
 --- Sparrow,  $\alpha = 16^\circ$   
 --- Sparrow,  $\alpha = 2^\circ$

$x = 0.104$

0

-0.1

-0.2

-0.3

-0.4

-0.5

-0.6

-0.7

-0.8

-0.9

-1.0

-1.1

-1.2

-1.3

-1.4

-1.5

-1.6

-1.7

-1.8

-1.9

-2.0

-2.1

-2.2

-2.3

-2.4

-2.5

-2.6

-2.7

-2.8

-2.9

-3.0

-3.1

-3.2

-3.3

-3.4

-3.5

-3.6

-3.7

-3.8

-3.9

-4.0

-4.1

-4.2

-4.3

-4.4

-4.5

-4.6

-4.7

-4.8

-4.9

-5.0

-5.1

-5.2

-5.3

-5.4

-5.5

-5.6

-5.7

-5.8

-5.9

-6.0

-6.1

-6.2

-6.3

-6.4

-6.5

-6.6

-6.7

-6.8

-6.9

-7.0

-7.1

-7.2

-7.3

-7.4

-7.5

-7.6

-7.7

-7.8

-7.9

-8.0

-8.1

-8.2

-8.3

-8.4

-8.5

-8.6

-8.7

-8.8

-8.9

-9.0

-9.1

-9.2

-9.3

-9.4

-9.5

-9.6

-9.7

-9.8

-9.9

-10.0

-10.1

-10.2

-10.3

-10.4

-10.5

-10.6

-10.7

-10.8

-10.9

-11.0

-11.1

-11.2

-11.3

-11.4

-11.5

-11.6

-11.7

-11.8

-11.9

-12.0

-12.1

-12.2

-12.3

-12.4

-12.5

-12.6

-12.7

-12.8

-12.9

-13.0

-13.1

-13.2

-13.3

-13.4

-13.5

-13.6

-13.7

-13.8

-13.9

-14.0

-14.1

-14.2

-14.3

-14.4

-14.5

-14.6

-14.7

-14.8

-14.9

-15.0

-15.1

-15.2

-15.3

-15.4

-15.5

-15.6

-15.7

-15.8

-15.9

-16.0

-16.1

-16.2

-16.3

-16.4

-16.5

-16.6

-16.7

-16.8

-16.9

-17.0

-17.1

-17.2

-17.3

-17.4

-17.5

-17.6

-17.7

-17.8

-17.9

-18.0

-18.1

-18.2

-18.3

-18.4

-18.5

-18.6

-18.7

-18.8

-18.9

-19.0

-19.1

-19.2

-19.3

-19.4

-19.5

-19.6

-19.7

-19.8

-19.9

-20.0

-20.1

-20.2

-20.3

-20.4

-20.5

-20.6

-20.7

-20.8

-20.9

-21.0

-21.1

-21.2

-21.3

-21.4

-21.5

-21.6

-21.7

-21.8

-21.9

-22.0

-22.1

-22.2

-22.3

-22.4

-22.5

-22.6

-22.7

-22.8

-22.9

-23.0

-23.1

-23.2

-23.3

-23.4

-23.5

-23.6

-23.7

-23.8

-23.9

-24.0

-24.1

-24.2

-24.3

-24.4

-24.5

-24.6

-24.7

-24.8

-24.9

-25.0

-25.1

-25.2

-25.3

-25.4

-25.5

-25.6

-25.7

-25.8

-25.9

-26.0

-26.1

-26.2

-26.3

-26.4

-26.5

-26.6

-26.7

-26.8

-26.9

-27.0

-27.1

-27.2

-27.3

-27.4

-27.5

-27.6

-27.7

-27.8

-27.9

-28.0

-28.1

-28.2

-28.3

-28.4

-28.5

-28.6

-28.7

---  $Q_{100}, \alpha = 0^\circ$   
 ---  $Q_{100}, \alpha = 0^\circ$   
 ---  $Q_{100}, \alpha = 0^\circ$   
 ---  $Q_{100}, \alpha = 0^\circ$

0.1

0

-0.1

-0.2

0.1

$x = 2$  inch

0

1

2

3

4

5

6

7

8

9

10

$\alpha$  in degrees

Figure 3 (Continued)

(g) Cantboard  $Z = 4.68$  Inches



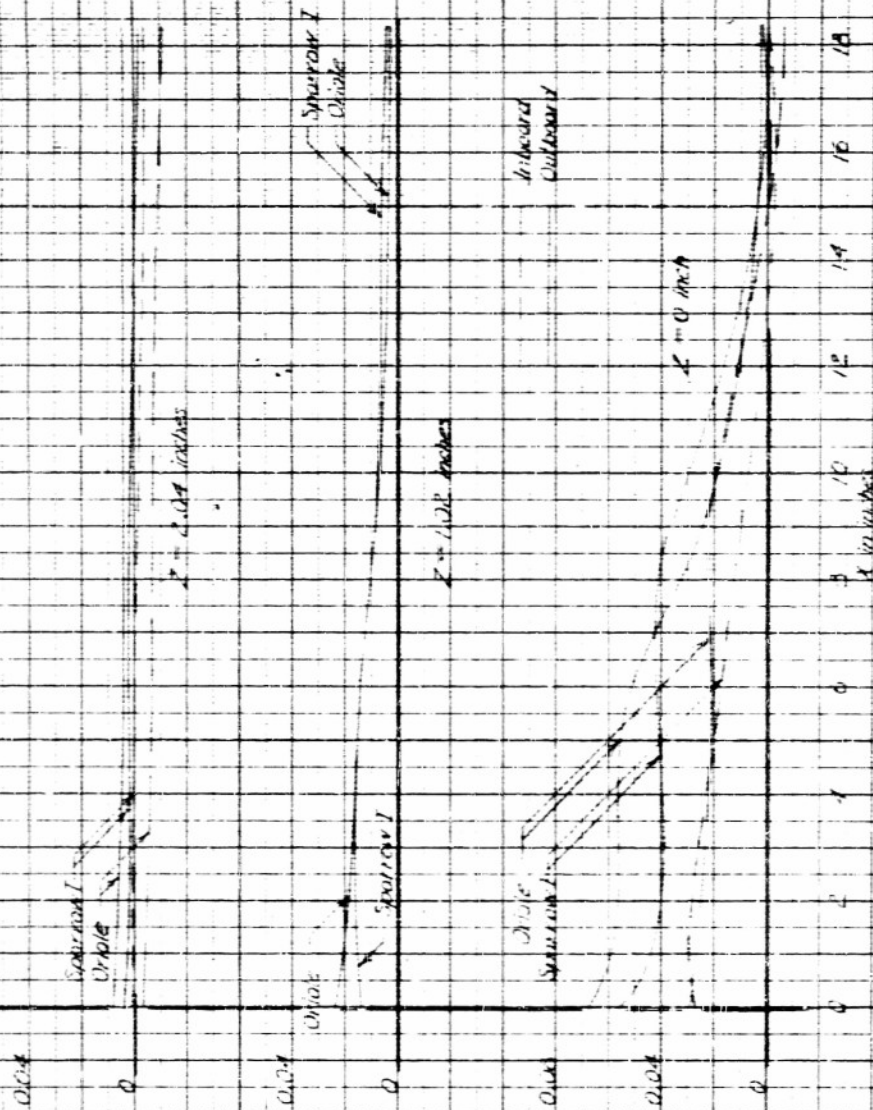


FIGURE 32 - VARIATION OF AIRPLANE INTERFERENCE ON THE ROLLING MOMENT COEFFICIENT OF THE ORLÉANS SPARROW I WITH DISTANCE FORWARD OF THE CARRY POSITION

$$\text{all } B_3 = 0, \alpha_3 = 0, \alpha = 4$$

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ARR 85-4

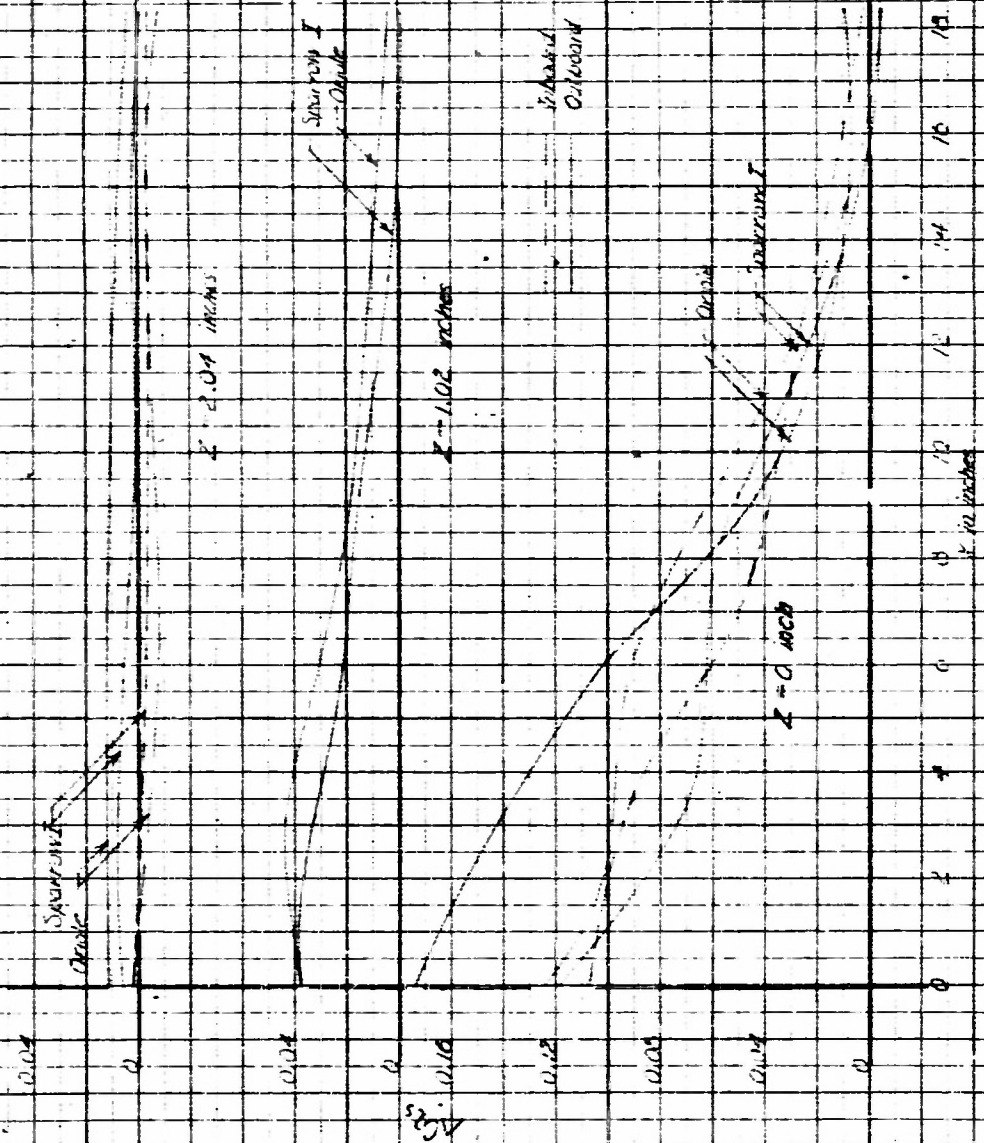


Figure 7.2 (Continued)

(b)  $E_s = 0.1$ ,  $\alpha_s = 5^\circ$ ,  $\alpha_c = 10^\circ$

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FIGURE 32b

ARR 85-4

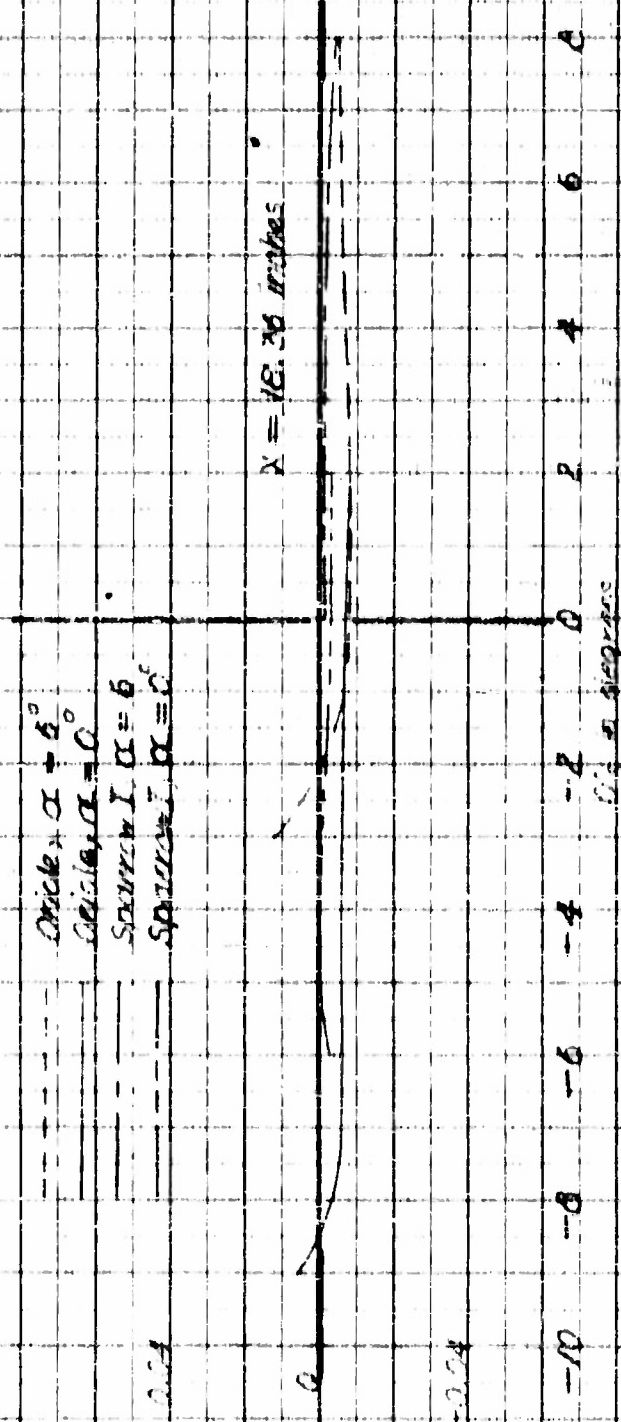


Figure 33—Variation of supersonic interference on the rolling-moment coefficient of X-2 Oriole and Sparrow I Missiles with missile angle of attack

(a) Intercom,  $\alpha = 0$  inch



0.04

2

200

0.04

2

Cracks,  $\lambda = 6'$   
 Cracks,  $\lambda = 6'$   
 Spacing,  $\lambda = 6'$   
 Spacing,  $\lambda = 6'$

$x = 18.38$  inches

$x = 9.19$  inches

$\alpha_0$  in degrees

-10

-8

-6

-4

-2

0

2

4

6

8

Figure 33 (Continued)

(Cracks,  $\lambda = 6'$ )

AEROSEA

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0.24

0

-0.04

0.04

$\Delta C_L$

0.04

0

-10

-5

-4

-2

0

2

4

6

6

6

Circle,  $\alpha = 6^\circ$

Circle,  $\alpha = 0$

Sparrow,  $\alpha = 6^\circ$

Sparrow,  $\alpha = 0^\circ$

$x = 18.36$  inches

$x = 13.26$  inches

$x = 6.12$  inches

$\alpha$  in degrees

Figure 33b (continued)

Circle,  $r = 1.02$  inches

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FIGURE 33c

REF ID: A7

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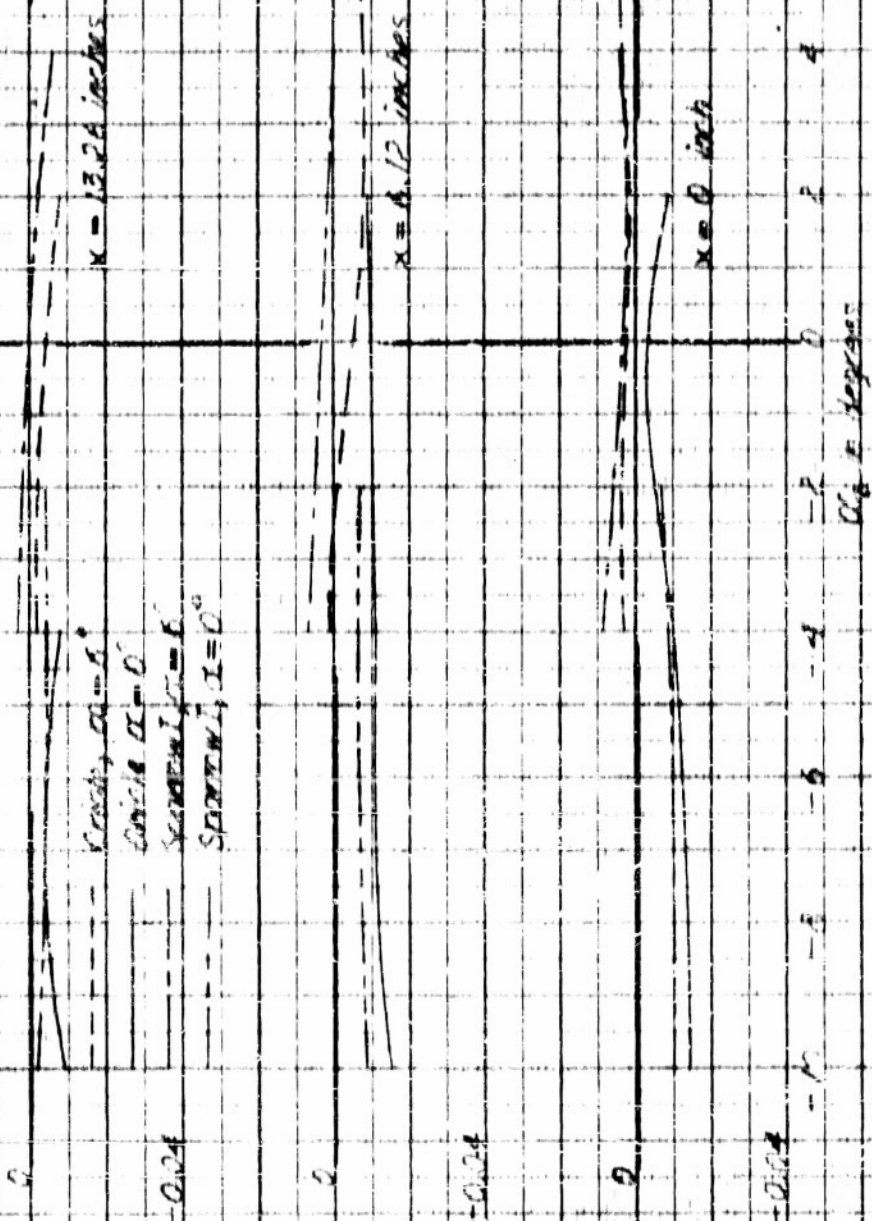


Figure 3.3 (Continued)

(a) Inboard,  $x = 2.04$  inches

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FIGURE 3.3



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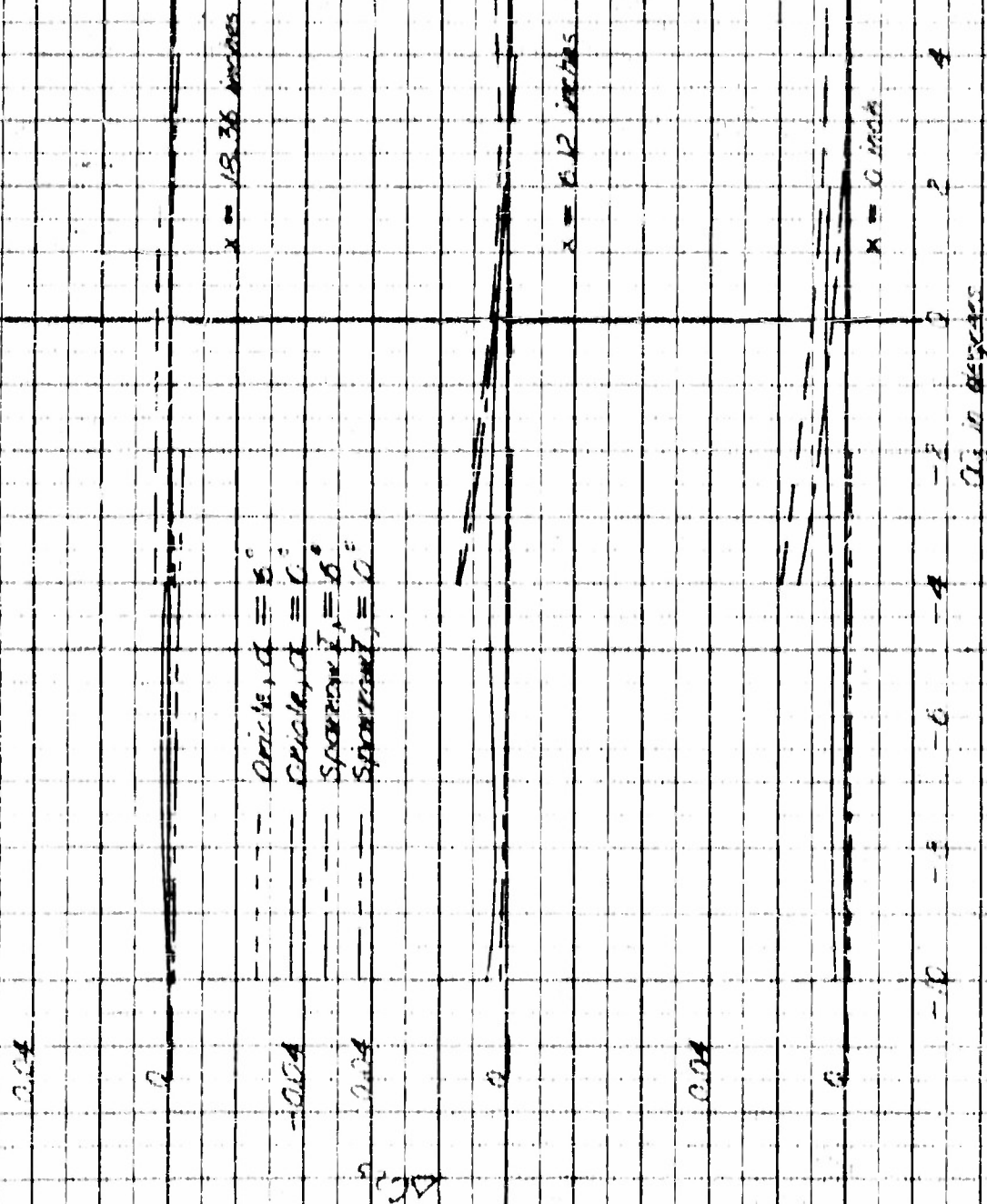


Figure 33 (Continued)

(e) Outboard,  $Z = 2.04 \text{ inches}$

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FIGURE 33e

--- Brick, 1 in. x 1 in.  
 --- Brick, 2 in. x 2 in.  
 --- Spacing, 1 in. x 1 in.  
 --- Spacing, 2 in. x 2 in.

x = 0.001 in.

deg. in degrees

Figure 33 (Continued)

(A) Inboard,  $Z = 4.08$  Inches

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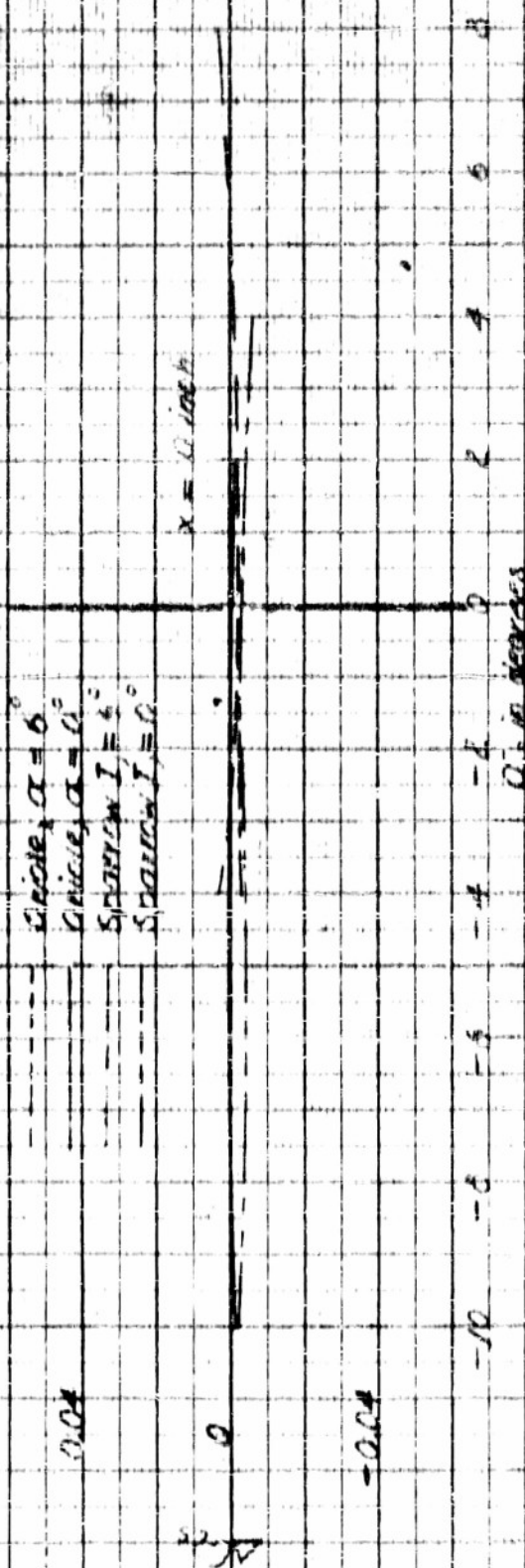


Figure 33 (concluded)

(Grounded,  $z = 4.0$  inches)

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FIGURE 33g



DTIC Aero Rpt 864 Pt. 2.

David W. Taylor Model Basin

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-44 ORACLE MISSILE AND COMPARISON WITH THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-42 SPARROW I MISSILE. PT. 2. MISSILES IN THE PROXIMITY OF A 0.179-SCALE MODEL OF THE F4D-1 AIRPLANE, by E.M. Brown. Wash., Aug 1958. 210p. Incl. illus. 5 refs. (Aerodynamics Lab. Aero Rpt 864 Pt. 2. Aero Test A-555. TED W80 AD 5158) CONFIDENTIAL

5-component strain-gage balance measured all missile forces & moments except axial force. Missile tested at 2 spanwise locations. 3 non-instrumented dummy missile models used to obtain interference effects due to proximity of missiles & effect of 4 missiles on plane.

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1. AIRPLANE (DOUGLAS F4D-1)
2. GUIDED MISSILES (SPERRY AM-4-2)
3. GUIDED MISSILES (MARTIN AM-4-4)
4. INTERFERENCE
5. EXTERNAL STORES
6. PULSUS
1. Brown, Elayne M.

DTIC Aero Rpt 864 Pt. 2

David W. Taylor Model Basin

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-44 ORACLE MISSILE AND COMPARISON WITH THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-42 SPARROW I MISSILE. PT. 2. MISSILES IN THE PROXIMITY OF A 0.179-SCALE MODEL OF THE F4D-1 AIRPLANE, by E.M. Brown. Wash., Aug 1958. 210p. Incl. illus. 5 refs. (Aerodynamics Lab. Aero Rpt 864 Pt. 2. Aero Test A-555. TED W80 AD 5158) CONFIDENTIAL

5-component strain-gage balance measured all missile forces & moments except axial force. Missile tested at 2 spanwise locations. 3 non-instrumented dummy missile models used to obtain interference effects due to proximity of missiles & effect of 4 missiles on plane.

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1. AIRPLANE (DOUGLAS F4D-1)
2. GUIDED MISSILES (SPERRY AM-4-2)
3. GUIDED MISSILES (MARTIN AM-4-4)
4. INTERFERENCE
5. EXTERNAL STORES
6. PULSUS
1. Brown, Elayne M.

DTIC Aero Rpt 864 Pt. 2

David W. Taylor Model Basin

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-44 ORACLE MISSILE AND COMPARISON WITH THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-42 SPARROW I MISSILE. PT. 2. MISSILES IN THE PROXIMITY OF A 0.179-SCALE MODEL OF THE F4D-1 AIRPLANE, by E.M. Brown. Wash., Aug 1958. 210p. Incl. illus. 5 refs. (Aerodynamics Lab. Aero Rpt 864 Pt. 2. Aero Test A-555. TED W80 AD 5158) CONFIDENTIAL

5-component strain-gage balance measured all missile forces & moments except axial force. Missile tested at 2 spanwise locations. 3 non-instrumented dummy missile models used to obtain interference effects due to proximity of missiles & effect of 4 missiles on plane.

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1. AIRPLANE (DOUGLAS F4D-1)
2. GUIDED MISSILES (SPERRY AM-4-2)
3. GUIDED MISSILES (MARTIN AM-4-4)
4. INTERFERENCE
5. EXTERNAL STORES
6. PULSUS
1. Brown, Elayne M.

DTIC Aero Rpt 864 Pt. 2

David W. Taylor Model Basin

WIND-TUNNEL TESTS OF THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-44 ORACLE MISSILE AND COMPARISON WITH THE AIRPLANE INTERFERENCE ON A 0.17-SCALE MODEL OF THE XAAM-42 SPARROW I MISSILE. PT. 2. MISSILES IN THE PROXIMITY OF A 0.179-SCALE MODEL OF THE F4D-1 AIRPLANE, by E.M. Brown. Wash., Aug 1958. 210p. Incl. illus. 5 refs. (Aerodynamics Lab. Aero Rpt 864 Pt. 2. Aero Test A-555. TED W80 AD 5158) CONFIDENTIAL

5-component strain-gage balance measured all missile forces & moments except axial force. Missile tested at 2 spanwise locations. 3 non-instrumented dummy missile models used to obtain interference effects due to proximity of missiles & effect of 4 missiles on plane.

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1. AIRPLANE (DOUGLAS F4D-1)
2. GUIDED MISSILES (SPERRY AM-4-2)
3. GUIDED MISSILES (MARTIN AM-4-4)
4. INTERFERENCE
5. EXTERNAL STORES
6. PULSUS
1. Brown, Elayne M.

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